Modern Project Collaboration

Web-Based Application in Construction

Title: ***Modern Project Collaboration: Web-Based Application in Construction***

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Contents

TABLE OF FIGURES III

ABSTRACT IV

ACKNOWLEDGEMENTS V

CHAPTER 1 - INTRODUCTION 1

1.1 Background 2

1.2 Terms of Reference 5

1.2 Terms of Reference 5

1.3 Overview of Research Report 6

1.4 Summary 8

CHAPTER 2 - LITERATURE REVIEW 9

2.1 The Rise of Modern Project Collaboration 10

2.2 Effective Team to Succeed 12

2.3 Web-based Applications as a Technological Resolution 14

2.4 Integrated Collaboration to Construction Project Value Chain 18

2.5 Investment of Time and Cost in Setting up a Web-Based Project 20

2.6 Summary 21

CHAPTER 3 - RESEARCH METHODOLOGY 22

3.1 Quantitative Method 23

3.1.3 Questionnaire Design 25

3.2 Qualitative Method 29

3.3 Summary 30

CHAPTER 4 - MAIN SURVEY AND ANALYSIS OF QUESTIONNAIRE 31

4.1 Section 1 of Questionnaire 32

4.2 Section 2 of Questionnaire 42

4.3 Section 3 of Questionnaire 50

4.4 Summary 58

Contents

CHAPTER 5 - CASE STUDY - QUALITATIVE RESEARCH MATERIAL 59
5.1 Project Background 60
5.2 Advantages of Extranet 61
5.3 Disadvantages of Extranet 61
5.4 Summary 62

CHAPTER 6 - LIMITATIONS OF RESEARCH 63
6.1 Quantitative Method: 64
6.2 Qualitative Method: 65
6.3 Summary 65

CHAPTER 7 - CONCLUSION AND RECOMMENDATIONS 66
7.1 Facilitating Information Management 67
7.2 Lack of Relationship Growth 68
7.3 Tentative Commercial Advantage 68
7.4 Trend of Cultural Changes in Industry 69
7.5 Recommendations: 70
7.5 Summary 73

BIBLIOGRAPHY 74

APPENDICES 77
Appendix A – Questionnaire Template 77
Appendix B – Multiple Choice Options 79
Appendix C – Respondent Score Sheet and Results 82
Appendix D – Interview Report 92

Table of Figures

Figure 4.1 – Respondents Profession 31
Figure 4.2 – Knowledge of Extranet 32
Figure 4.3 – Correlation of Age and Knowledge Level of Project Extranet 33
Figure 4.4 – Respondents' Experience in Using Extranet 34
Figure 4.5 Usage of Project Extranet in Correlation with Project Cost 35
Figure 4.6 Correlation of Business Sector and Knowledge Level of Project Extranet 36
Figure 4.7 – Project Extranet Experience in Correlation with Business Sectors 37
Figure 4.8 – The Prevalent of Extranet in Future and its Reasons 38
Figure 4.9 – The Possible Area that Extranet Could Change Project Delivery 39
Figure 4.10 – Attitude in Using the Project Extranet in Future 40
Figure 4.11 – Attitude in Using Extranet in Future in Correlation with Business Sector 41
Figure 4.12 – Time-Distance Communication Matrix 42
Figure 4.13 – Tradition vs. Modern Way of Working 46
Figure 4.14 – Flexibility and Accessibility of Working and Documentation 47
Figure 4.15 – Communication Approach 48
Figure 4.16 – Responsibility of Maintaining the Extranet System 49
Figure 4.17 – Results Matrix of Web-Based Application (Respondents' Opinion) 50
Figure 4.18 – Majority Agree / Strong Agree Areas for Benefits Brought to Projects 52
Figure 4.19 – Over Half Agree / Strongly Agree Areas for Benefits Brought to Projects 53
Figure 4.20 – About Half Agree / Neutral Areas for Benefits Brought to Projects 54
Figure 4.21 – More Participants Disagre Areas for Benefits Brought to Projects 55
Figure 4.22 – Majority Agree / Strong Agree Areas for Benefits brought to Business 56
Figure 4.23 – More Participants Disagree Areas for Benefits brought to Business 57

Abstract

Fragmentation is one of the biggest weaknesses in the construction industry that has lasted for a long time. For sure it requires the support and application of new techniques and technologies to modernise in order to deal with the recurring problems. The traditional way of working and paper-based systems introduced the barrier of project collaboration and inefficiency in exchanging information. With the application of information technology, project teams are finding solutions to eliminate the disintegration when working with each other. The user of Project Extranet acts as the interface across the network and the system is designed for improving the business-to-business relationship. Notwithstanding the business opportunities leveraged through technology, or new technology exploited by the business, both initiatives are necessary for full realisation of the strategic of information technology. This paper aims to see the web-based application which uses the modern information flow in restructuring and bringing the team together. It also reflects the problems and recommendations highlight in both Latham (1996) and Egan (1998) Reports. By investigating the key issues relating to the web-based system approach, it obtains deep understandings of stakeholders' perspective and its impacts to collaboration. Primary research and a case study in a live commercial project that uses the Project Extranet, are developed to analyse the influence of project collaboration in practice. The aim of this dissertation is to see how the web-based applications enable effective real-time information flows, communication and knowledge sharing across the project team in strengthening collaboration; and whether the immature construction Extranet market provides any return on investment.

Keywords: Web-based application; project collaboration; Project Extranet; information flows; electronic data management system (EDMS)

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Amy Kam

3 September 2005
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Chapter 1 - Introduction

This chapter introduces the application of the latest information technology to the construction industry. It emphasises the needs of improvement in construction projects which relies on team building and the appropriate use of IT software. The amalgamation of web-based application and project collaboration in construction projects is developed into the title of this research report.

1.1 Background

1.1.1 Emergent of electronic transmission in construction projects

The rise of IT and electronic communication brought individuals and industries to a new generation. Nowadays people are more knowledgeable than before from gaining information and connections via internet, that is using a speedy and accurate transfer of information at low costs. Technically, "Internet" is a universal public channel in networking whist "Extranet" is a private system in sharing business's information or operations between the related partners. In another words, Extranet is a web-based protocol that intends to add value to products or services by using the latest available technology.

With large participation in R&D, the first Project Extranet was established in 1995 (Stevenson, 2005). In addition to the partnering concept mentioned in the Latham Report (1994), the construction industry moves a big step forward.

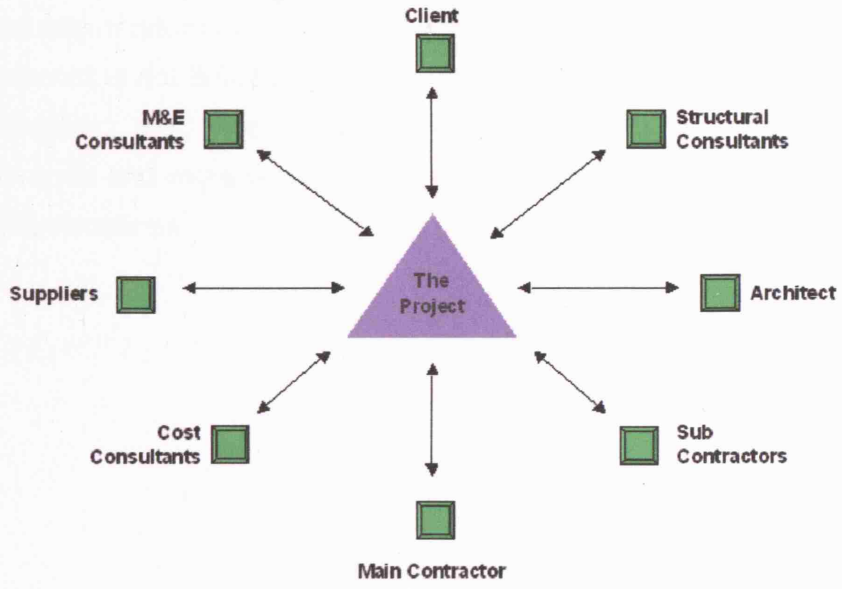
1.1.2 Function of Extranet in project delivery

A successful project relies on assembling a client's unique requirements via providing best value at all levels of the project delivery process. The current advanced information technology in Extranet system allows real-time accessing of the project documents and drawings through the internet. Not only acting as a modern tool for project management, but Extranets also provides an operational platform for information and communication flows for collaborative working.

1.1.3 Bringing teams together through intense communications

Project collaboration involves a group of "high-performing" team with good co-ordination. During the design stage, collaborative design requires an easy flow of information between all participants (Austin, 2001). Conversely, by using the remote access via Extranet, development of building could be viewed across the interactive construction site once the work commences. Communication is therefore a key role that leads to an effective collaboration. From time to time, the ways of communication in delivering construction projects change from multi-points-responsibility network to centralised single-point-responsibility to (see Figure 1.1). For that reason, information is more compact and easier for accessing. The transformation distinguishes the efficiency and openness of information flows and communication channels between the traditional and modern approaches.

Figure 1.1 Communication after web-based application



[Source: Model of Centralised network occurring during the construction phase. (Emmitt and Gorse, 2003)]

1.1.4 Coalesce organisations into networks

Trust and confidence are subsequently developed through co-operation. Another advantage of the project web-based applications is to build relationships between organisations. Nohria & Eccles (1992) believes that all organisations are networks of relationships and Winch (2002) suggests that the construction coalition is considered as a network of information flows. With the application of an Extranet, the process and communication across the project team develops. Thus, it improves collaboration and integrates the supply chain.

1.1.5 Different attitudes of web-based contributions

The participation of web-based applications adds value to organisation learning via circulation of information flows and knowledge exchange. An improvement in the business performance can be forecasted as a long-term strategy. However the web-based application in construction is at its early stage and there are some drawbacks as a perfect project management tool, such as user training of the system is needed and the rate of returns in terms of investment might be low in short term. That is why the Extranet is not broadly used at every construction projects since its launching. Nevertheless, the topic of web-based applications in construction becomes controversial and more researches are carrying out from different participants with different disciplines.

1.2 Terms of Reference

1.2.1 Scope

The user of a Project Extranet as a collaboration tool is still in its infancy within the construction industry. Therefore, the heavy focus on project management in relation to web-based application is to support recommendations and findings.

Furthermore, the research from both users and suppliers concentrates on the Extranet framework and its effectiveness with linkage to construction projects.

1.2.2 Objectives of the Research

- To evaluate the potential contributions of web-based application to the value chain in project delivery.
- To determine the structural changes to project collaboration in terms of communication and social networks subsequent to the web-based application
- To investigate the ownership and maintenance responsibility of Extranet system
- To realise the difficulties in applying Extranet to all different construction projects in reality
- Give alternative suggestions to improve the efficiency of the Extranet

1.3 Overview of Research Report

There are seven chapters in this report, it includes:

Chapter 1: Introduction

Background information of the Extranet and project collaboration in construction projects is briefly specified to support the research. Chapter 1 covers the perception of the report title, objectives of the research and the whole structure of the thesis.

Chapter 2: Literature Review

Theories from the industry reports, textbooks and internet references are used as the basis of the main study. They built the fundamental concepts for this research. The main contents include the rise of modern project collaboration and how the Extranet is applied as the technological resolution. They are linked to compare against the research findings in later chapters.

Chapter 3: Research Methodology

Primary and secondary data are gathered to do the research (Howard et al, 2002). A questionnaire regarding the experience and opinion of respondents in using the Extranet is designed. It aims to carry out the quantitative method of survey. Besides, a case study of an experienced Extranet user is adopted to achieve the qualitative research material.

Chapter 4: Main Survey and Analysis of Questionnaire

Responses from 60 participants with various experiences in using Extranet are taken into account for the analysis. All the findings are evaluated and explained, using the statistical method, in this chapter.

Chapter 5: Case study – Qualitative Material

A case study of an active web-based applied construction project is used. Analysis on the application, benefits and pitfalls are assessed. The results are to compare with other project that does not use Extranet. The interview based on the user's point of view. Thus the problems came up from the application of Extranet will take into account of its drawback in real practice.

Chapter 6: Limitations of Research

Both the quantitative and qualitative researches were carried out; however there were some constraints in the questionnaire design and survey process. This chapter illustrates the problems experienced throughout the research and distinguishes from the expectations mentioned in Chapter 3.

Chapter 7: Conclusion and Recommendations

Through the survey analysis and case study, an attempt will be made to support the notion that Extranet does contribute to project success and collaboration. On the basis of the literature review, recommendations will be made on how web-based application should evolve to be able to cope with different procurements and different types of projects. My recommendations include how Extranet can enhance the project collaboration process and create another project management trend.

1.4 Summary

Owing to the effectiveness of the Extranet may bring long term benefits to the construction industry, it worth to look into depth of how the web-based system could apply successfully in real practice. This research title appeals to me because of its diversity of development of IT and its value that brings to the construction industry which are precious to my career and many construction organisations.

The content of the report consists of four main themes, this includes:

1) Why do we need modern project collaboration?

2) How the web-based applications take place?

3) What do we expect to change from web-based applications?

4) Are we achieving what we want?

Chapter 2 - Literature Review

The first part defines how web-based application adds value to project collaboration. This bases on the improved information flow and communication channel to the value chain of a project that gains from Extranet system. The later part focuses on how the organisations establish, operate and manage the new integrated Extranet systems in construction project; and how the Extranet bring opportunities to the construction business.

2.1 The Rise of Modern Project Collaboration

"The success of construction projects is increasingly reliant on collaboration between all members of project team. This collaboration is increasingly reliant on 'joint up' technology, knowledge sharing, standardisation, effective information flows." (CIRIA, 2004)

The British construction industry in the 1990s experienced some very significant changes in its markets and its operating environment. Amongst the changes, Latham (1996) suggested the possibility in identifying the acceleration of information technology and its impact on both the construction office and construction site. In the "Constructing the Team" Report, Latham recommended the co-ordinated project information in conjunction with the preparation of a full matrix of documents should be made part of the conditions of engagement of the designer; and the consultants must make the client aware of the risks of incomplete design. He advised the consultants should get specific "signing off" approval from clients, whereby the clients need to aware of the consequences for the construction programme in terms of possible delays. Moreover, throughout the process, the emphasis must be on meeting the client's needs and keeping the client fully informed of potential risks.

A clear direction of improving the information and co-ordination within the project team was proposed in the Latham Report. The reason behind was to maximise the efficiency of project collaboration and to reduce the fragmentation that continuously exists in the construction industry. The suggestion of co-ordinated project information intended to solve the deficiencies in preparing the information necessary for the builder so the client could have higher certainty in achieving the project on time and within budget. However the traditional ways of working and resources implies a restriction in fulfilling the recommendation. It hinted the construction industry needs an innovation to overcome its weaknesses.

From the same point of view, Egan (1998) recognised that modernisation is urgently needed to solve the construction industry problem. He put forward that good IT as an essential part of improving the efficiency of construction. He believed the application of new technology as a tool in the design of buildings and their component, and in exchange design information throughout the construction team is very useful. However he argued the lack of investment in research and development of the construction industry is damaging the industry's ability to keep abreast of innovation in process and technology. Both the philosophies and perceptions of Egan and Latham have a same approach in utilising the technology to improve project collaboration.

> *Construction companies can seldom be accused of spending money unwisely, but they can waste a great deal inadvertently. Through collaboration, even the inadvertent waste is now being tracked down (Cole, 2000).*

With the development of IT and its applications in other industries, it can be seen a transformation of organisational culture. The changes involve a wide range from the business network to team structure and new ways of working. This totally reflects the influence of technology gradually becomes a key driver of business. Construction companies have a heavy reliance on the exchanging information between clients, architects, designers, engineers and quantity surveyors, as well as contractors and specialists, etc. Electronic information system is therefore becomes an effective tool in the construction process.

2.2 Effective Team to Succeed

"If a team is to reach its potential, each player must be willing to subordinate his personal goals to the good of the team."
(Wilkinson, 1994)

Without good team building or coordination, conflicts would increase as the team grows bigger. It is necessary to maintain cooperation from time to time. To make these happen, efforts for cooperation are required from the individuals. In general, the quality that the effective team (Pinto and Millet, 1999) should have the following features:

1) a clear sense of mission,

2) an understanding of interdependencies,

3) cohesiveness,

4) trust among team members, and

5) a shared sense of enthusiasm.

The challenge is to get the different group of individuals with different backgrounds, attitudes, mind-set, and objectives and form them into a team. That is why the individual requires the cross-functional skills to carry out their work, meanwhile they could do with allegiance to go along with the rest of the team. When working together in a construction project, the project team involves individuals coming from different professions, for example, architect, quantity surveyor, structural engineer, civil engineer, etc. They offer different skills and complete the work for the same project. All of them are interdependent as they insist on team cooperation. It would not be easy to establish the relationships between themselves unless they have the

mutual thinking which takes time and endeavour to develop. Even the team building was succeeded in the first place, the members still ought to trust each other to continue the project collaboration.

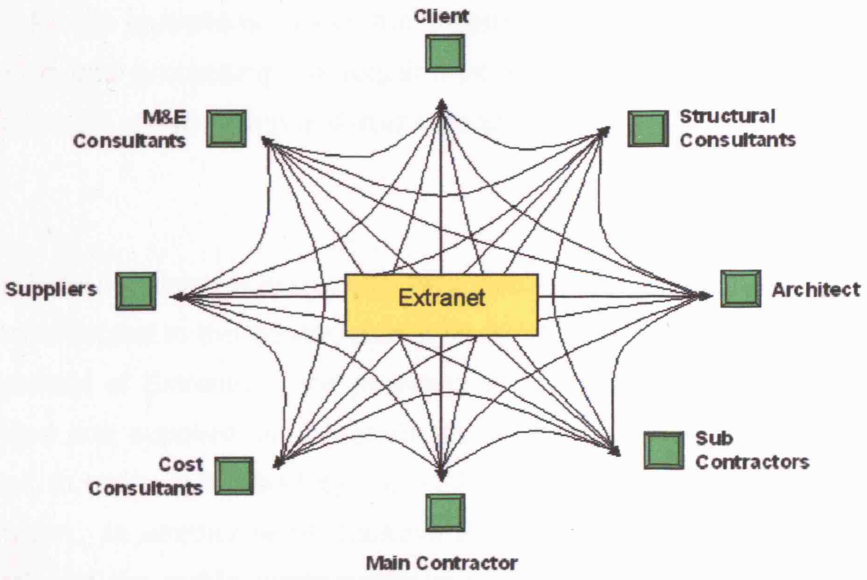
Cross-functional cooperation becomes the essential factor for project collaboration. The study of cross-functional cooperation on project teams (M.B. Pinto 1988) stated the importance of super-ordinate goals, rules and procedures, physical proximity and accessibility which can help encourage cross-functional cooperation. Within the project organisation, the group would have an overall objective, for examples, it makes use of the Extranet to enable a fast and easy access of documents. The client's target is to minimise the timing in exchanging information so as to achieve the project completion on time; meanwhile the architect uses the applications of the Extranet to reduce the data transmission period and increases client satisfaction. To make this happen, all the individuals of the team are required to put efforts from their functional areas or at least compromise the primary goal.

To facilitate the web-based applications in projects, rules and procedures are essential to support the centralised shared system. The reason for that is to offer a means for coordinating or integrating activities that involve several functional units (Galbrath 1977). Unfortunately the Extranet holds off the physical interaction and communication within the team so the physical proximity does not exist. However it tries to provide a space in the web for a virtual project organisation rather than endow with a physical building or meeting room. The idea is to encourage the individuals to work together with each other. The last but not least is the approachableness of the individuals in the group. The Extranet aims to make the team easier in getting access of each other providing the whole team take the initiative in using the Project Extranet and carry out the cross-functional cooperation.

2.3 Web-based Applications as a Technological Resolution

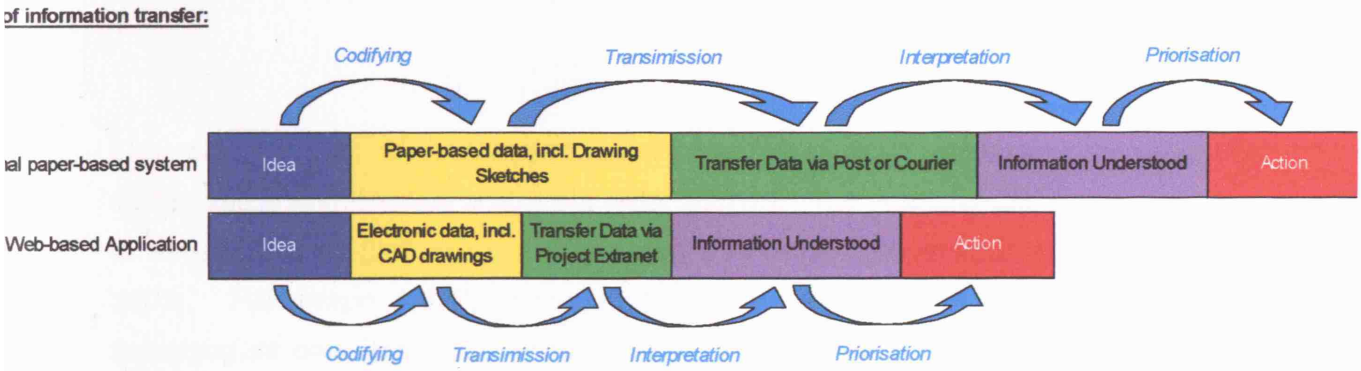
"If only the flow of information could be improved..."
(Joint Contracts Tribunal, 1998)

The electronic information flows save the circulation of paperwork and reduce the chances of delay caused by distance of destinations. At the organisational level, web-based applications provide a shorter path in exchanging information to reduce the bulk paper documents which are produced, moved, handled, corrected, transcribed and copies in normal business practice. Project-specific websites and Extranets are critical in the efficient capture, analysis and sharing of information that results in meeting deadlines within budget. The ideal target is to offer more opportunities for consistent document review, multi-party collaboration and expanded communications between the project teams. Thus, the web-based application forms a network between the project team members from different organisations.



[Source: Schematic of possible interactions in a network. (Emmitt and Course, 2003)]

Information is more freely to be obtained by each project team where a single shared database is used. Meanwhile before the emergent of EDI, the information transfer is less efficient. In terms of the information transfer cycle within construction, both the traditional and modern transmission are carrying out the same tasks but shorter time is required throughout the process, as show below:



The effectiveness of the information flow can be measured by the differences of overall time taken which have a significant effect on reaching the project completion date. At the operational level, the project team members could find easier in accessing and processing the required information, and consequently the system strengthen the teambuilding and trust among the team.

Project Extranet which is exclusively designed for project management is introduced and implemented to the construction projects alongside technological development. The concept of Extranet is the restricted access internet service that is operated, controlled and supplied by the application service provider (ASP) for use by and licensed to users authorised by the ASP for sharing of electronic documents and information. In another word, Extranet is a private network that uses the internet protocol and the public telecommunications systems to share securely part of a business's information or its operations with suppliers, vendors, partners, customers

or other businesses. The concept of the electronic data management systems (EDMS) is to create a definable, centralised, controlled and secure environment where information can be shared and exchanged (Kenny 2002). The EDMS is flexible to cope with an enterprise, project or work group of any size at any part of the world. The system is described as a collaborative tool that can form a single, centralised and consistent resource for all project information, promoting co-ordination and control, as well as efficiency and productivity.

The development of web-based application generates interactions between companies in relationships and in the wider network. The relationships are believed to be easier managed with the change of technological co-operation (Ford et al, 2003). Hakansson (1987) illustrated two types of effects of relationships on technological development which are the "interactive effects" and "complementary effects". Under this circumstance, the new knowledge of the web-based applications which appears at the border between existing bodies of knowledge is known as the interactive effect; that is, the interaction between the IT companies and construction companies can generate new thinking. Meanwhile, the cost of the new technology increases and the number of technologies are required to operate in any application grows. Hence, the complementary effects are associated with the growing needs for companies to specialise in the Extranet development.

Chapter 2

"The construction industry needs to move from simply reproducing paper-based processes in an electronic form and enable machine – machine and person – machine communication." (Finch, 2000)

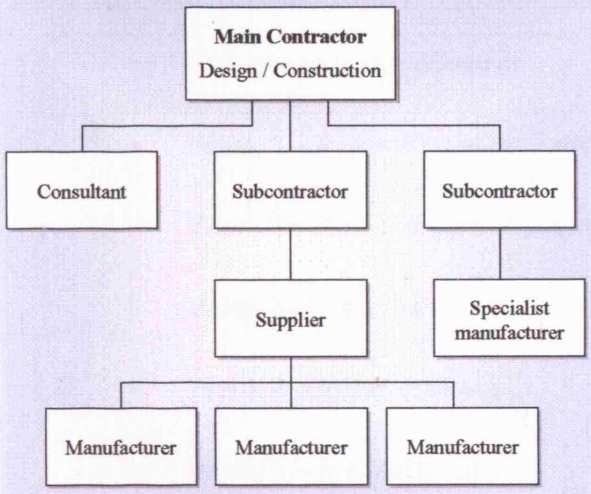
The most effective communication is to transmit and respond to the right message to the right person at the right timing. In a construction project, the case could be the project manager identified a potential risk which require the attention and responses from the relevant participants. As the communication is multi-party, a centralised system is preferred to used to avoid misinterpretation during transmission. The concept of Project Extranet is a to build a single network for communication between members. The integrated network encourages users to make joint decisions and implement knowledge management providing the level of access defined. Biggs (1997) argued communication as the root cause of most project failures. This is due to the fact that current project management practices are often isolated and have a lack of integration within the supply chain. She suggested the latest web-based solutions which can be linked with email or collaborative software can reduce the incidence of people related issues and overall communication problems which lead to project failure.

2.4 Integrated Collaboration to Construction Project Value Chain

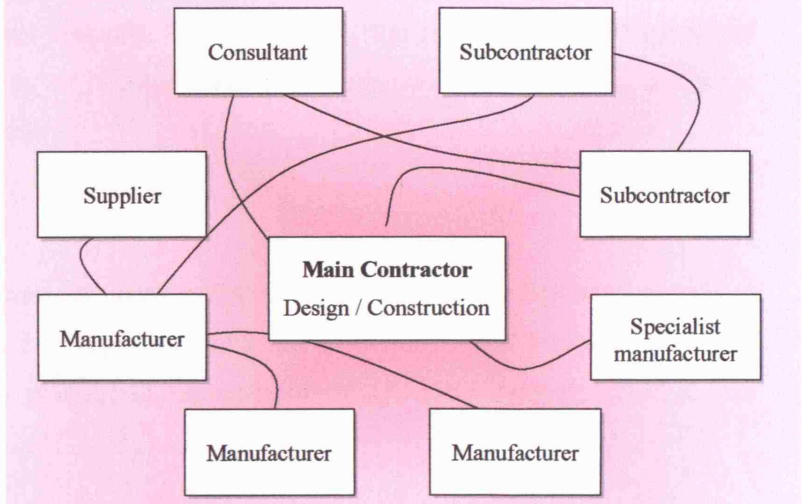
Collaboration of a project relies on a centralised, single-point approach that can facilitate the communication flow effectively. The input of the whole process should be carried out by people but not the system as the web-based application is a tool only. This is because effective collaboration requires the ability to make joint decisions that will promote the overall performance of the produce over individual disciplinary concerns. The web-based application enables the site and the office to work collaboratively in reviewing documents and extensive communications. The purpose of it is to develop new ways of team working within a project and allows high level of transparency. In another word, the collaboration between all members of the project team is boosted by the integration of technology, knowledge sharing, standardisation, and effective information flows. The project value system involves the project chain and supply chain (Winch, 2002) and the relationship is both horizontal and vertical governance. The web-based application acts as a resource agent in delivering the project value between the client and suppliers through the business-to-business relationship. The web-based collaborative Extranets are increasing interest to the construction industry, mainly due to the development of partnering and to allow greater input from the supply chain. The overall added value is taken into account as its sustainability and long-term improvement that offered to the industry.

From time to time, the construction industry uses the traditional project structure that defines a clear hierarchy and span of control. No matter which procurement method is adopted, the "hierarchical structure" remains the same. The only solution is to have a centralised system and get rid of the span and control. The Extranet system is one of the solutions that allow the hyperlinks of the network to replace the hierarchy links. Evans and Wurster (1997) described that as the hyperarchy. The following two diagrams show the contrasts of the "hierarchical project structure" and the "hyperachy project structure". The hyperarch demonstrates how the value chain

is being deconstructed. Thus the new structure enables the specialist consultants and subcontractors to have more direct influence on the design and construction process. Meanwhile the main contractor is acted as a facilitator who also monitors the process and progress instead of being an executor. The whole idea is to encourage the collaboration attitude among the project team and make the team more effective, rather than putting too much control over the team and mislead the supply chains via the traditional structure.



[Source: Finch (2000) Traditional hierarchical project structure



[Source: Finch (2000) Hyperarchy – deconstructed value chain of construction project

2.5 Investment of Time and Cost in Setting up a Web-Based Project

As an end-user, the time required to set up a Project Extranet is about 5 weeks (Mockler, 2004). Seamus Mockler, who is responsible for implementing and managing the BIW Information Channel Project Extranet for Kajima Construction Europe, illustrate the process in setting up a Project Extranet as follow:

- 5 minutes to set up
- 5 weeks to make effective
- Week 1 – Agree to use an Extranet
- Week 2 – Agree extent of documentation
- Week 3 – Establish project protocols
- Week 4 – Initial Training
- Week 5 – Implementation

The fee for the implementation of Extranet varies and it depends on the service providers, and also the functions and usage duration as requested. In general, the initial charge of the Extranet includes the installation, set up, training and technical supports. Then the monthly or regular payment comprises the additional trainings and maintenance of the system.

Although it takes time to set up, implement and training, the anticipated return of investment is to gain from the "real time" process and delivery of information. This increases the certainty of project to be completed on time through shorten the working period.

CAPITAL INVESTMENT MOVE TO JAH - PACKING PROGRAMME

SPACE	PACKER	ESTIMATED NO. OF FILES	(NUMBER OF CABINETS TO PACK FILES FROM)	OTHER
Annie's desk	Annie	33	0	Tray
Shabber's desk	Shabber		0	Tray
Tim's desk	Tim	5	0	Tray
Oyin/Nancy's desk	Nancy	10	0	Tray
James' desk	James	0	0	
Janet's desk	Janet	12	0	Tray
Rachel's desk	Rachel	0	0	
Sue's desk	Annie	31	1	20 files under desk. Tray
Fiona's desk	Shabber	0	0	Paper in chest. Tray
Recertification and Partial Completions	Simon + Rachel	0	0	
EGA (facing corridor)	Tim + James	73	5	
Meeting Room 7 (includes Blue Books and Clinical Closeouts)	Karen + Amy (Janet)	206	0	

2.6 Summary

The theory of cross-functional cooperation and the importance of information exchange via communications bring out the main theme of the web-based applications. The technology is employed to create a tool so that it enables the team to work effective within the centralised network and raise productivity. However in this research, we aim to see whether this concept is feasible in reality or not.

Chapter 3 - Research Methodology

The questions focus on areas as mentioned in the objectives. Quantitative and qualitative methods (Crestwell, 2003), are chosen to do the research. To obtain a high level of response, a questionnaire with multiple-choice format was designed with a 38 questions. Moreover, an interview was carried out with an end-user to empathise the practical application of Extranet.

3.1 Quantitative Method

3.1.1 Reason for using the Questionnaire

The main survey was carried out by collecting the primary data in August 2005. A questionnaire was designed and distributed to a random of construction related companies via email. There is no limit for the distribution of the questionnaire and an assumption of a high level of responses tends to achieve a more accurate result from the sampling. A full content of the questionnaire template and the choices of the answer are illustrated in Appendix A and Appendix B respectively.

The questions focus on areas as mentioned in the objectives. From the literature review, a clear direction is illustrated that the web-based application which uses the high technology of information and telecommunication to act as agent in solving the project collaboration problem. The web-based project collaboration tool also extends its basic function to knowledge management and risk management. This point of views is explicable in theory as others can see how Internet or the IT development can improve other industries or businesses predominantly. However we have to take a deep look at the effects and changes of the construction projects in the real world.

3.1.2 Hypotheses of the Research

My hypotheses for this research include the following four points:

- Web-based made contributions to project management process including allocation of tasks and tracking progress.
- Real-time information flows improve the situation of time, cost and quality in meeting the targets with minimal risks.
- Project team builds stronger relationships through electronic communication channels.
- The Extranet provides a centralised platform for sharing knowledge and the practice strengthens the supply chain.

3.1.3 Questionnaire Design

All the questions in the questionnaire are closed questions. In order to obtain a high level of responses, the multiple-choice and Likert scale (Underwood, 2003) format is designed with 38 questions in four main sections. The questions in the questionnaire are illustrated in following:

(1) Participant's experience in web-based applications;

1. How well do you know about Extranet ?
2. If so, how many project you work on involves using the Extranet ? (present and past)
3. Do you think if Extranet would become more common in future ?
4. Why you agree Extranet would become more common later ?
5. If the Extranet applies to your project, will you think that could help to improve project delivery ?
6. What do you recognise that the project could be to improve with the application of Extranet ?
7. Are you happy to use Extranets on future projects ?

The first section concentrates on the respondent's perspective and experience of the Extranet. This section is design to find out the trends in the construction industry. Straightforward questions are asked and the options of answers are not more than five selections. The results are analysed independently or in co-relationship with section 4.

(2) Participant's subjective opinion on project collaboration;

8. - Face-to-face meeting
   - Communication via post, fax, voice mail, email, etc.

9. - Use notice / bulletin boards within an organisation
   - Use telephony, video conference, electronic group discussion / editing facilities

10. - Traditional way of working, i.e. paper-based system
    - Modern way of working, i.e. computer-based system

11. - Documents should be accessed at the work place within normal hours
    - Flexible access of documents even out of office or beyond official working hours

12. - Centralised, single-point communication approach
    - Decentralised, multi-points communication approach

13. - Client is liable to provide the system and training that uses for project delivery
    - Project team is responsible for using and learning the project delivery system

Questions 8 and 9 are about the ways of project collaboration which distinguish the differences between the time and distance. The results of both questions are used to represent in a matrix format. Therefore we can find out whether time or distance is the key driver of project collaboration, and if the Extranet is lying in the same quadrant.

Question 10 is underlying the theory of the "sides of champion behaviour" (Pinto and Millet, 1999). This question aims to identify the changing culture in the way of working in the construction industry.

Question 11 reflects the changing way of working and the result should have a similar trend as previous question.

According to the communication principle, there are two distinct ways of communication within the corporate, either centralised or decentralised. Question 12 aims to find out whether the trend of responses would fall on the centralised one, which is after the web-based application.

Question 13 is a commercial question of who should pay for the Project Extranet. It was raised in the preface of the RICS research paper (Breetzke and Hawkins, 2001)

(3) The influence of modern project collaboration in reality;

	Project Related :
14.	- Integration of the appropriate technology
15.	- Better knowledge sharing
16.	- Effective Information Flow
17.	- Access to a rich history
18.	- Promotes best practice
19.	- Troubleshooting and re-working of designs
20.	- Enhanced communication channels
21.	- Time, cost and quality are more certain
22.	- Better understanding of project team
23.	- Clearer project organisational structure
24.	- Increase efficiency and productivity
25.	- Higher transparency of information exchanged
26.	- Facilitate decision making
27.	- Improved co-ordination and accessibility
28.	- Standardisation of project tools and methods
	Corporate Related :
29.	- Improved business relationships
30.	- Associates business processes with documents and records
31.	- More opportunities for partnering
32.	- Long term benefits to industry
33.	- Cost savings on document management

Likert Scale with five options of answers are used in this section. Questions 14 to 28 are statements related to the effect of web-based applications to project and questions 29 to 33 are related to corporate.

All the statements listed in this section are supposed the benefits of the web-based application in construction projects. The various statements are extracted from different sources, including the CPN Report (Hosker 2002) and books including Davidow and Malone (1993) and Finch (2000).

Assuming the whole list illustrated the advantages of Extranet, and then the outcomes from the responses would be easily spot on whether the trend is falling on one side or any outstanding issue that requires further investigation.

(4) Participant category.

34. Are you a ...
35. Your age group is :
36. Which one is the best to describe your organisation ?
37. Which is the major sector of the projects you are involving ?
38. What is the average project cost of your recent projects ?

The final section is to find out the respondent's personal details including their age, professions, major sector of industry and the average size of projects they are involving. The results are to evaluate with the first section.

The research aims to use the quantitative method in defining the attitudes of individuals in adopting the Extranet system in project delivery and how it could affect the patterns of changing collaboration as a whole. The questions and format of the questionnaire is simple and straightforward as I intend to have a high level of responses; also the design of questions takes consideration of the non-Extranet users who may find the complex questionnaire too "technical" to them.

3.2 Qualitative Method

3.2.1 Reason for using the Individual Interview

Individual interview with an end-user is chosen for the second part of the research. This is carried out after the collection of the questionnaires. The interview includes open questions that do not appear in the questionnaire and questions that brought up from the questionnaire. Interviewee is also freely to give own opinions regarding the topic.

This method is believed the best way to obtain a detailed answer more than a simple "yes" or "no" answer. Due to the research takes into account the direct effect of the web-based application from user's experience, therefore an individual interview in-depth is preferred.

3.2.2 Selection of Interviewee

Baerbel Schuett is selected as the particular interviewee for this research. Currently, she is the Project Director at Cyril Sweett Ltd (an international project management consultants firm), and she has the background in using the Extranet provided by BIW on one of her major projects in Bristol. As a senior position in the company, she has more authority and idea in managing and viewing the web-based applications in her specific project. Also, taking into account her experiences on other projects, it would add more valuable findings to the research.

3.2.3 Design of Interview Questions

The interview questions are enclosed in Appendix D. In general, the interview is formal but flexible, therefore the questions are used as the guidelines for the interview and there is no right or wrong to the answers.

3.2.4 Interview Process

Firstly, Baerbel Schuett is required to tell about the background of the project, the objective and motivation of the web-based application in her project. Then questions regarding the advantages and disadvantages in using the Extranet are asked to define. It focuses on the value that gained or lost from using Extranet in terms of both project-oriented and organisational-oriented. The major question relates to the behaviour of the team is also demanded as this is the issue cannot be obtained from the primary research. Lastly, a few queries are raised from the unexpected results in the questionnaire.

3.3 Summary

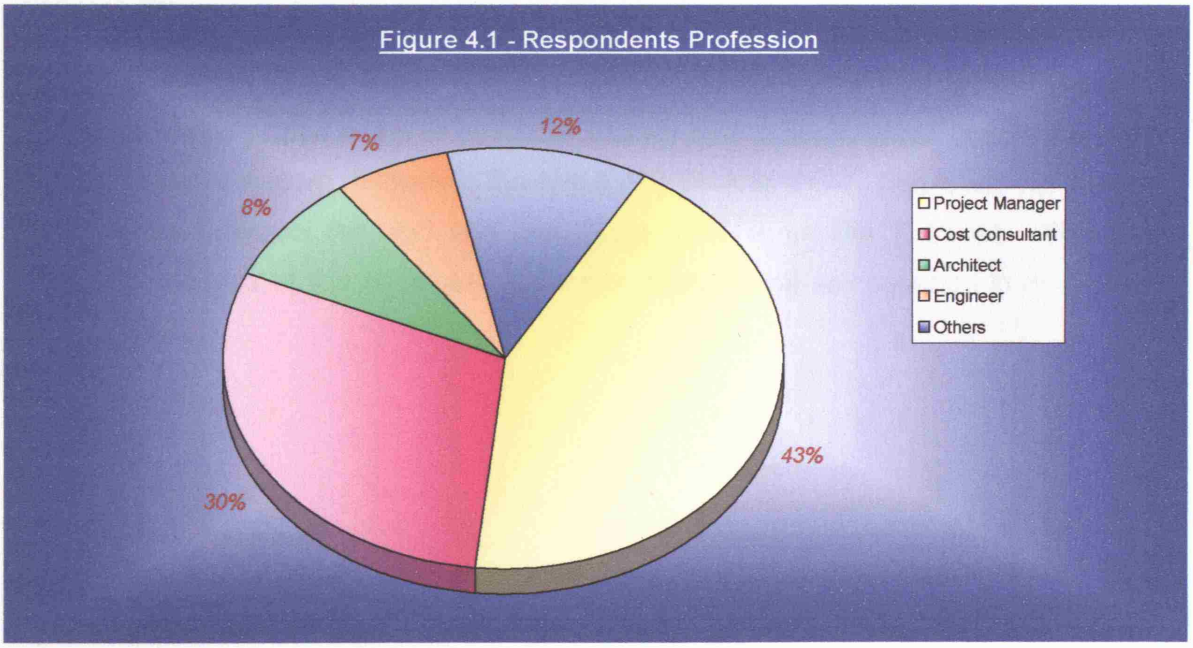
The collection of both primary and secondary data results will be used to examine the effectiveness of Extranet in practice. Multiple-choice questionnaire and individual in-depth interview are carried out in doing the research. Limitation of the research is described in more details in Chapter 6. The analysis of data in the next chapter will focus on determining whether the web-based application could improve project collaboration and further partnership opportunities. Collected data will be analysed and illustrated in statistical and graph formats. The findings would examine the results from the research.

Chapter 4 - Main Survey and Analysis of Questionnaire

The investigation lasted for one week and a total of 60 responses were received. The results are illustrated in Appendix C. The following evaluation uses the graphs and charts to represent the statistical results. Figures are either shown in percentage or number of respondents. The following three sections in this chapter correspond to the first three sections of the questionnaire, whilst the results of section four in the questionnaire is used to correlate to the first section.

A majority of participants who took part in this survey are working in consultant companies and the rest are from the contractors. A detail of the respondents' profession is illustrated in Figure 4.1.

Figure 4.1 - Respondents Profession



4.1 Section 1 of Questionnaire

Individual experience is considered as the key element in examining the recognition of Extranet in respondent's work practice. The outcome would have an effect on how they conceive the successfulness of the modern project collaboration.

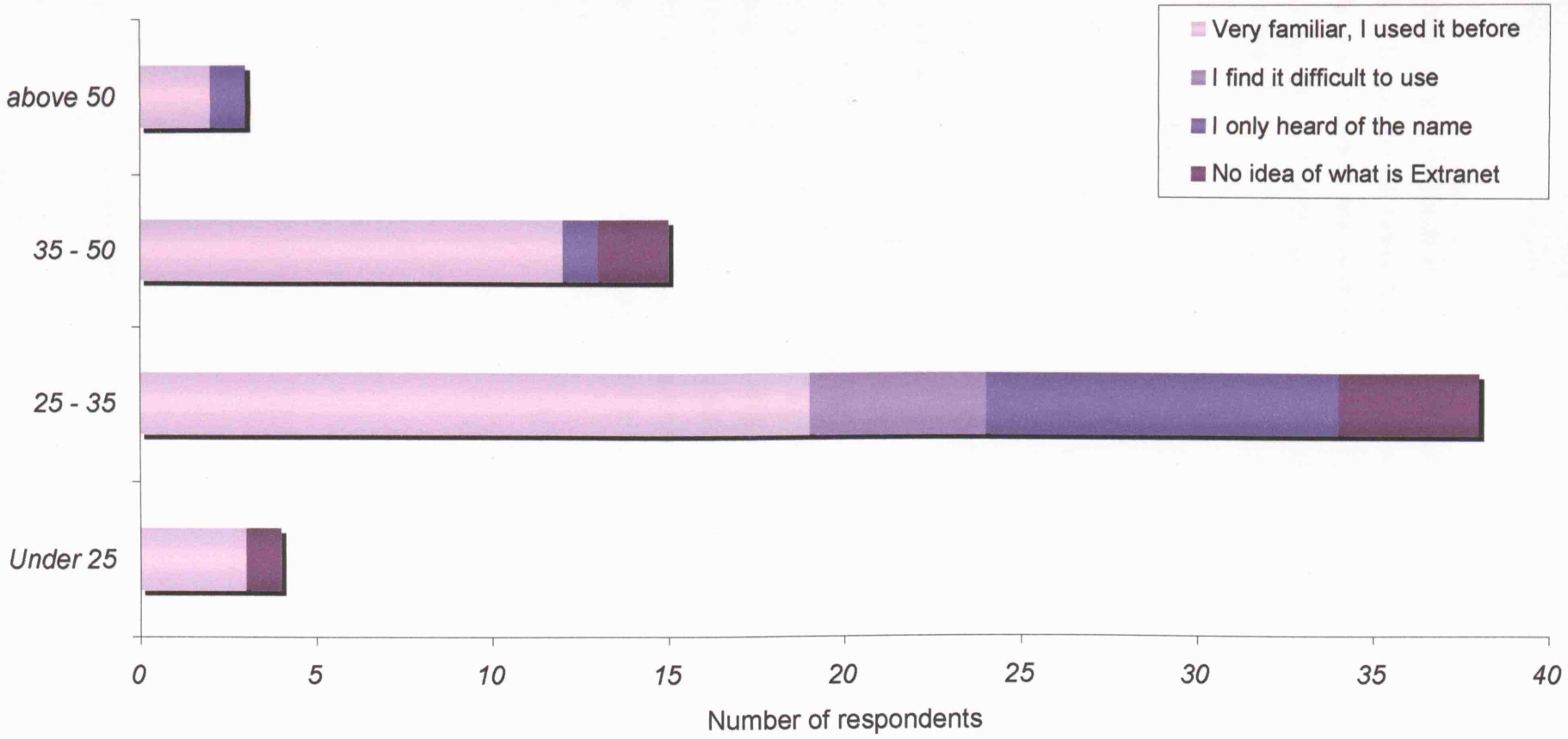
In this research, over half participants used the Extranet before and only 12% of the respondents do not know what exactly Extranet (Figure 4.2). This could be due to lack of investment in government projects and high confidentiality in project information, for example, prison and defence projects.

Figure 4.2 -

Very familiar, I used it before	**58%**
I find it difficult to use	**8%**
I only heard of the name	**22%**
No idea of what is Extranet	**12%**

It is interesting to find out the correlation of the knowledge level of Extranet and age group as well as the business sectors. An assumption of the younger generation (under 35) would have a higher computer literacy and hence a better understanding of the Extranet system. However the result (Figure 4.3) shows that it has no direct relationship between the age and knowledge level about the Extranet. This is possibly because of the computer and online applications are common in daily life and at work.

Figure 4.3 - Correlation of Age and Knowledge Level of Project Extranet



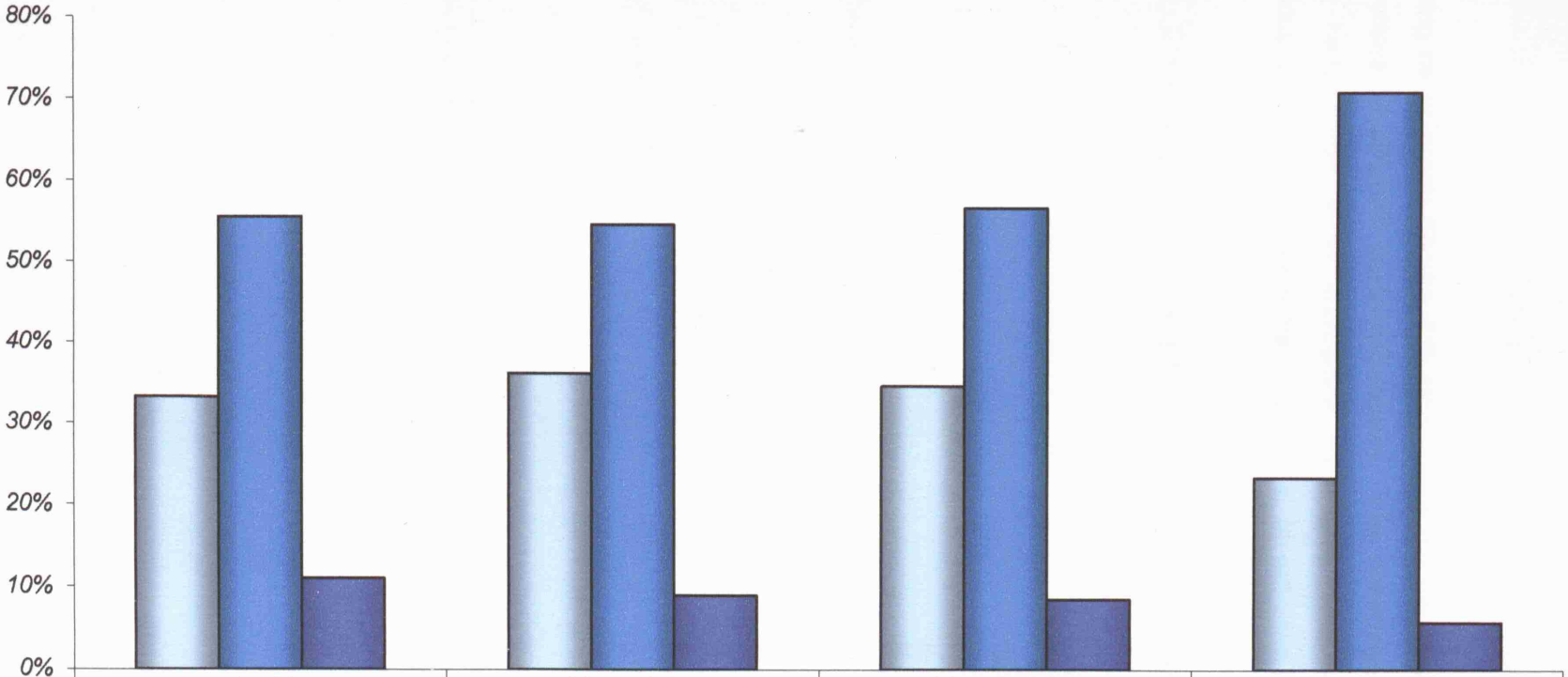
Almost one third of the respondents have no experience in using the Extranet (Figure 4.4), it is because their projects do not use the entire system. On the other hand, only 8% of participants are very experienced in using the Extranet in five or more of their projects. It can be seen that the web-based application is still at its development stage.

Figure 4.4 -

1. None	19	32%
2. One to five	36	60%
3. More than five	5	8%

In the survey, 15% works on small projects of project costs under £1m; 18% works on medium projects of project costs between £1m to £10m; 38% works on large projects of project costs between £10m to £50m and 28% works on very large projects of over £50m in project costs. There is not any specific trend indicating the relationship of project cost and the usage of Extranet (Figure 4.5). Among all the sizes of the projects, there are occasions of using the web-based applications and vice versa. Apart from the very large project group, all categories have about one-third of workforce never use Extranet, and about half of them uses Extranet for one to five times already. Only the very large project group has the lesser experience in using the Extranet.

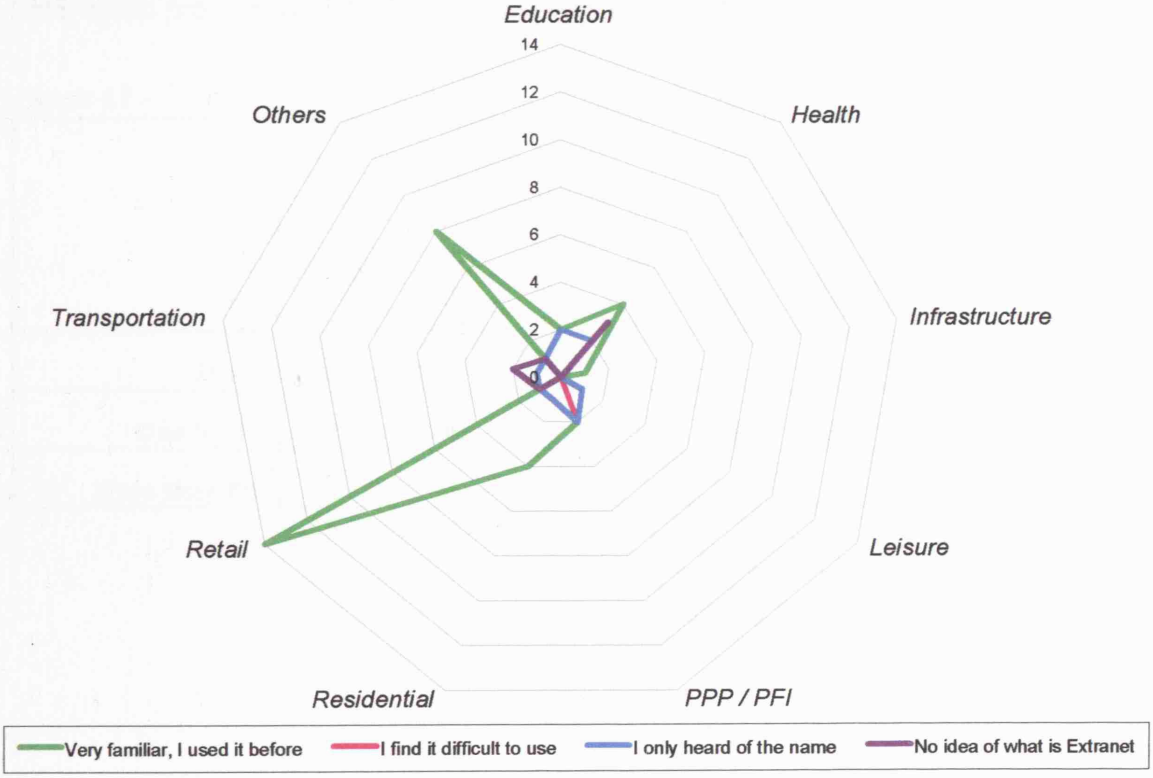
Figure 4.5 - Usage of Project Extranet in correlation with Proejct Cost



	under £1m	£1m to £10m	£10m to £50m	above £50m
None	33%	36%	35%	24%
One to five	56%	55%	57%	71%
More than five	11%	9%	9%	6%

The following radar graph (Figure 4.6) also shows the knowledge level of Project Extranet relates to different business sectors. The participants in Retail Sector appear to have much better knowledge than other sectors, followed by the miscellaneous group which include the Commercial, Mixed-used and other sectors.

Figure 4.6 - Correlation of Business Sector and Knowledge Level of Project Extranet



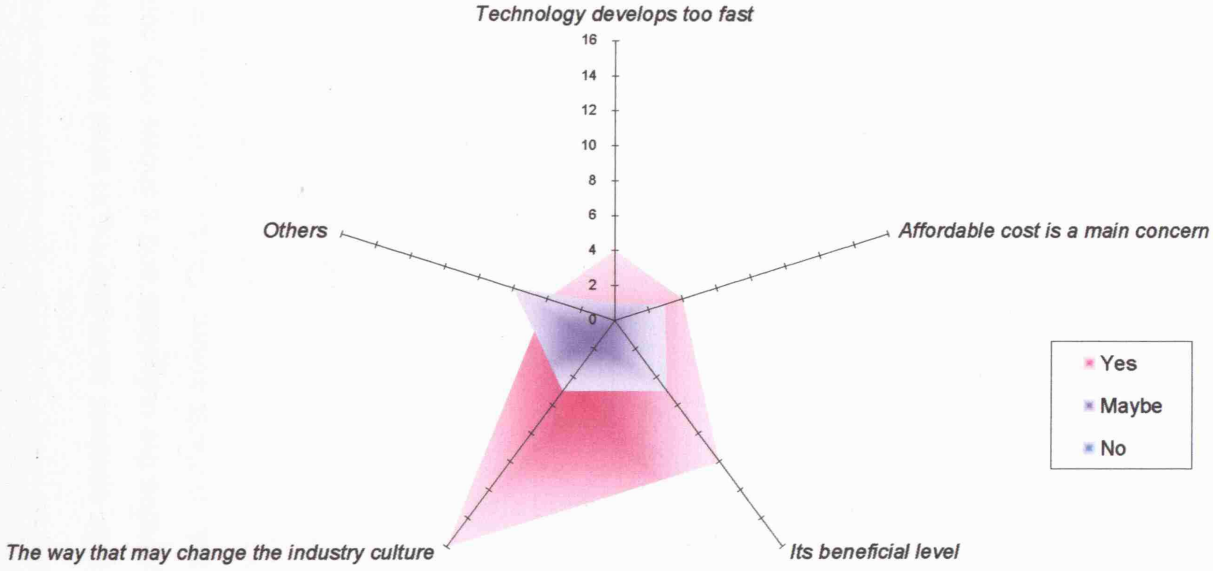
Assuming all the participants only work on one major sector so far; it is more likely that the participants in retail sector have the highest usage of Extranet than any other sectors meanwhile the health project team has the least experience (Figure 4.7). This can be explained by the nature of the business, from the level of external resources requirement to the actual needs of the tool, for example, the shopping centre project may include the participation of the anchor tenant's architect but the NHS health projects would rather rely on their in-house project teams.

Figure 4.7 -

	Education	Health	Infrastructure	Leisure	PPP / PFI	Residential	Retail	Transportation	Others
None	*2%*	*10%*		*2%*	*3%*	*3%*	*3%*	*3%*	*5%*
One to five	*7%*	*8%*	*2%*		*7%*	*7%*	*17%*	*2%*	*12%*
More than five							*7%*		*2%*

It is not surprised to have 63% of the respondents are of the same mind that the Extranet would become more common in future. Many of the respondents see the results (Figure 4.8) as the way that may change the industry culture and because of the beneficial level that Extranet brought. Lesser respondents think the Extranet is the upshot of the technology developments and same ratio considers about the costs. For the same question, 33% of them think the web-based application may be more popular later and only 3% disagree with the statement.

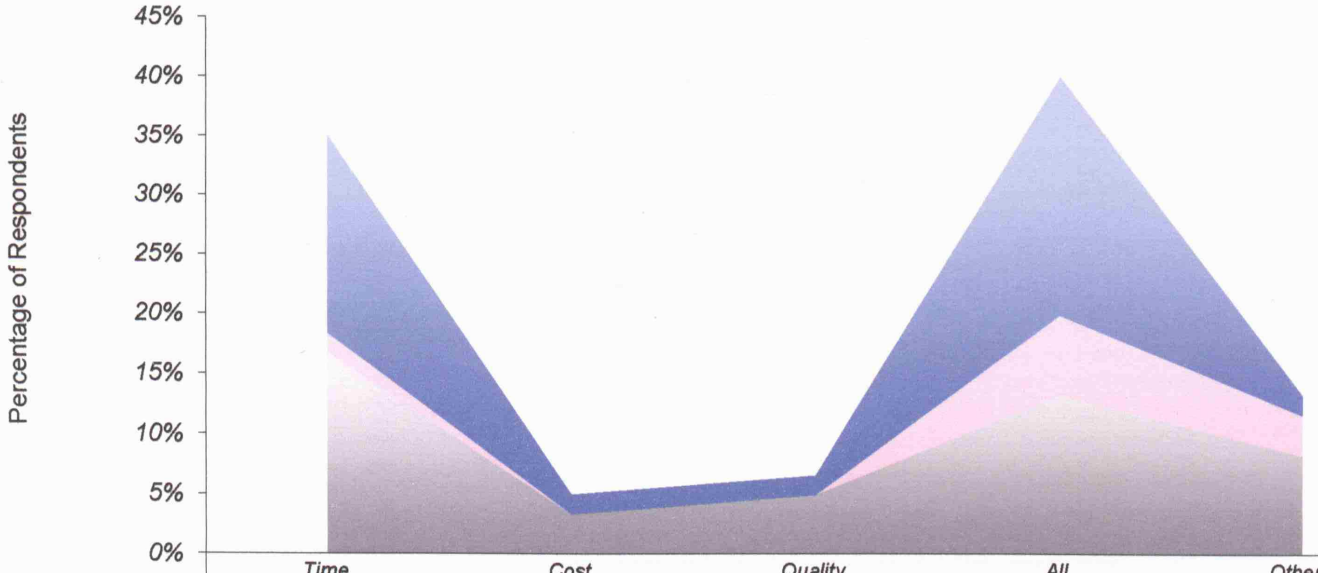
Figure 4.8 - The prevalent level of Extranet in future and its reasons



Although the Extranet seems gradually adoptive by the industry, not the same portion of respondents agrees that the use of Extranet can actually improve their present projects. 42% of participants think Extranet can help their current project versus 47% who disagreed; and the rest of the 12 % assume that the web-based applications might able to improve the project delivery.

Respondents were asked to express their opinions on explaining in what ways the Extranet could improve or worsen their projects. The graph in Figure 4.9 illustrates the outcomes and it shows only some respondents would think the Extranet could change the costs or quality of their projects solely. On the other hand, more respondents believe that time and a combination of time, cost and quality would be more significant in the way of changes to their projects.

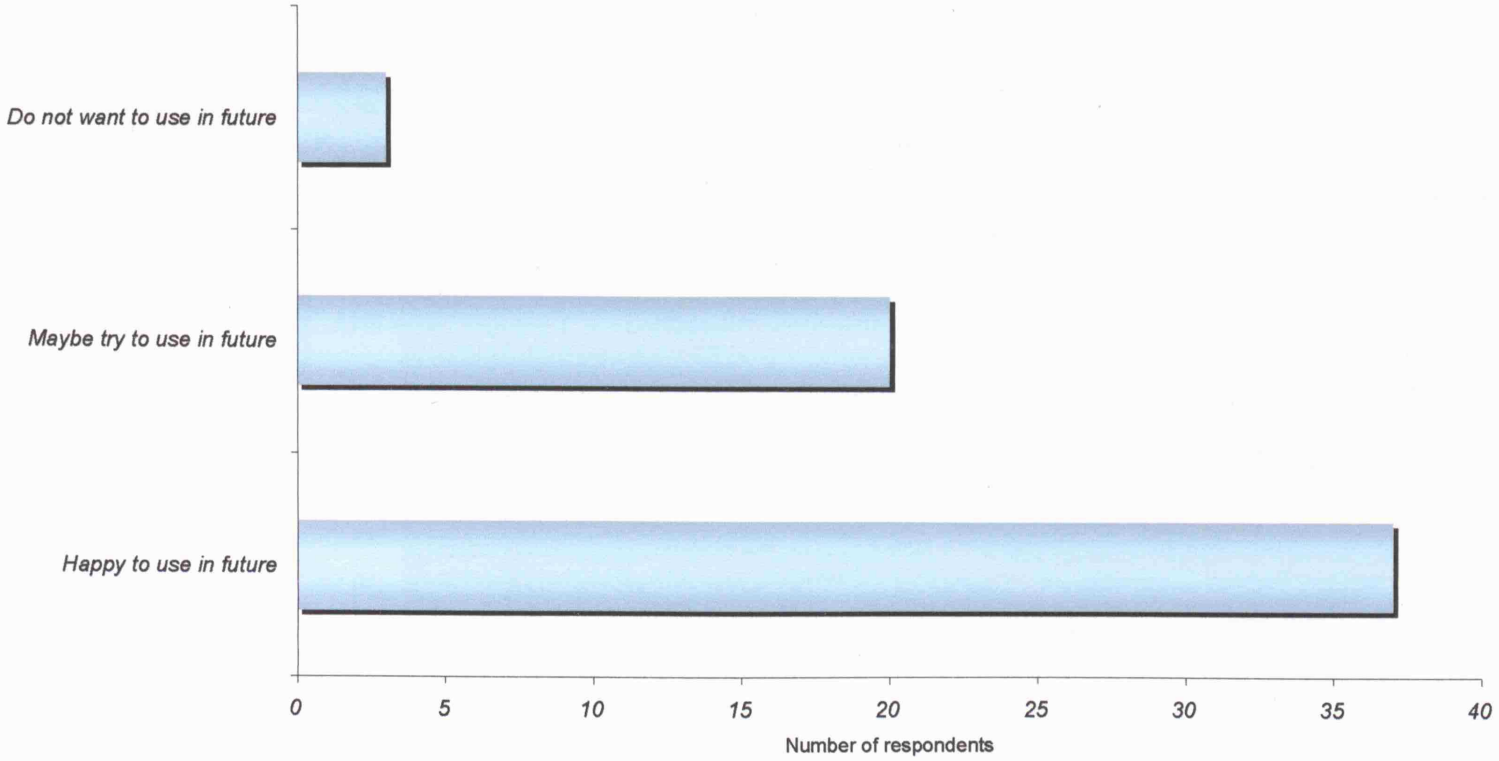
Figure 4.9 - The possible area that Extranet could change project delivery



	Time	Cost	Quality	All	Others
Area could be improved	17%	2%	2%	20%	2%
Area might be improved	2%	0%	0%	7%	3%
Area could not be improved	17%	3%	5%	13%	8%

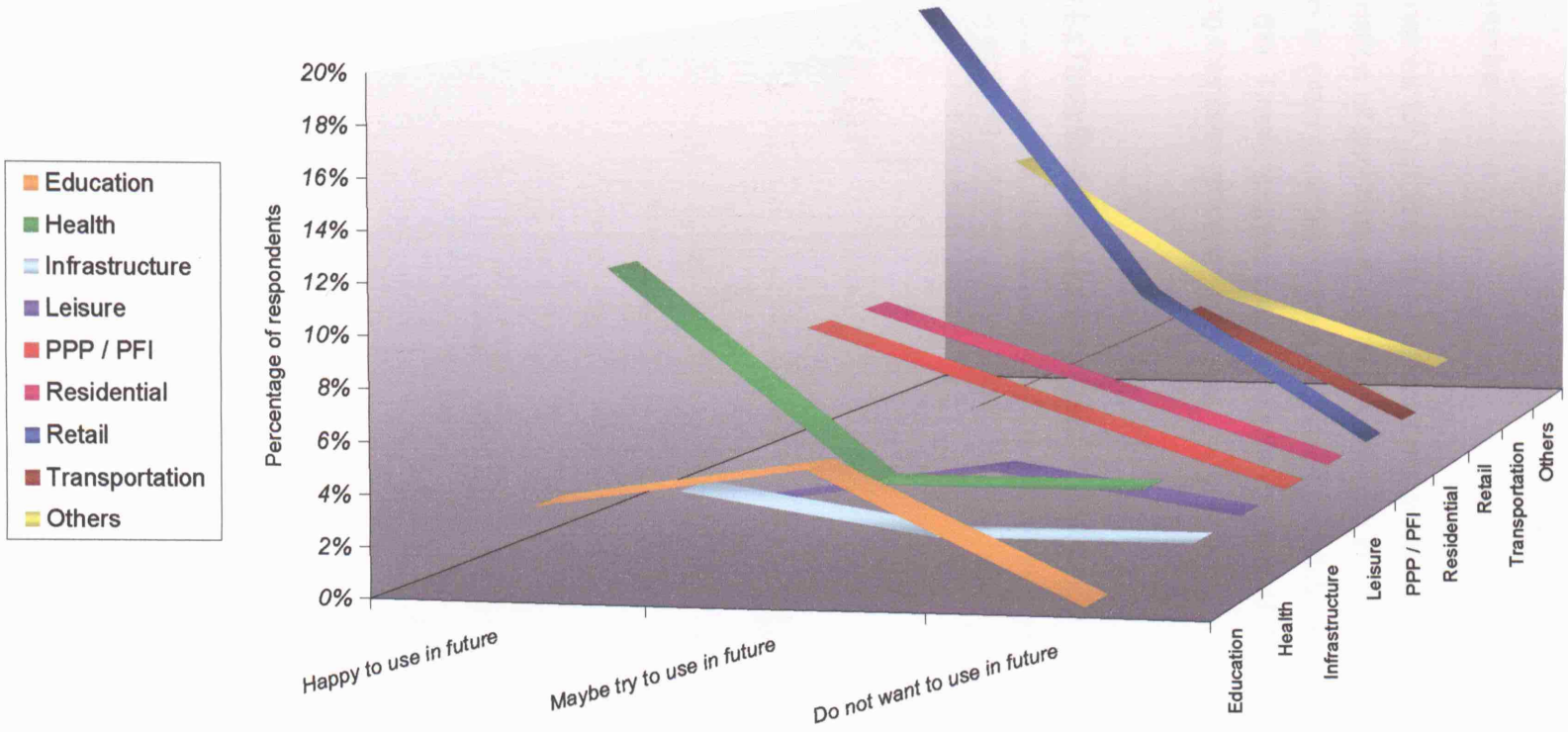
The last question is to identify the attitude of respondents in the using the Extranet in future. The trend in Figure 4.10 demonstrates over than half of the respondents are happy to use in future and about one third of them would try in using it. Only three of the respondents do not want to apply it in forthcoming projects.

Figure 4.10 - Attitude in using the Project Extranet in future



If we look at the same result in correlation with business sectors (Figure 4.11), the Retail sector seems very keen on using the Extranet and none of them do not wish to apply it in future. Conversely, the respondents in Health sector are also enthusiastic about the application of Extranet but some are opposed. This is possibly relates to the nature of their projects in which they could not recognise the benefits from the web-based applications.

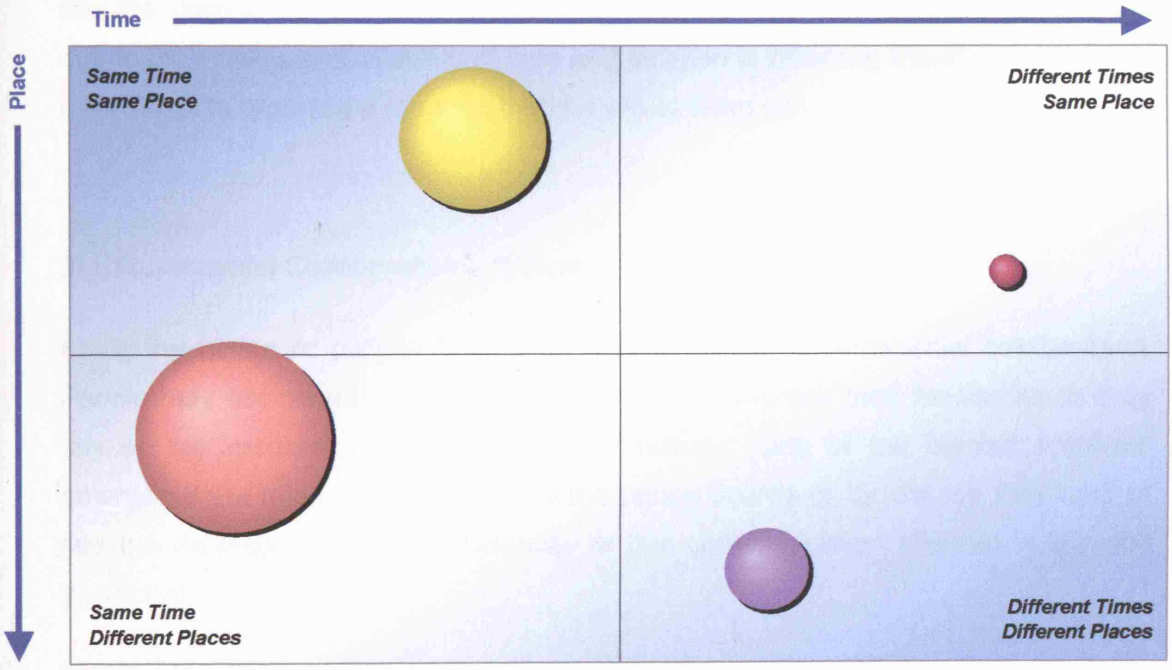
Figure 4.11 - Attitude in using the Project Extranet in future in correlation with business sector



4.2 Section 2 of Questionnaire

This section offers two choices for participant to select their preference of project collaboration. The combination of questions 8 and 9 is to identify the most effective way of the communication in order to achieve the best possible collaboration. The results are illustrated in the Time-Distance Communication Matrix (Figure 4.12) which includes the following four core groups:

Figure 4.12 - Time-Distance Communicaiton Matrix



1) Contiguous Collaboration – "Same Time, Same Place"

This includes the regular face-to-face meetings, for example, design team meeting, where the team members assemble at the designated venue of the same time. It provides an open space for people to greet each other and have an immediate response through direct communications. The sociable environment helps to develop personal and business associations.

This is the second most popular choices from the survey. Although the face-to-face meeting is a traditional method in communication and collaboration, it is hardly to see the disadvantage of this fundamental and approachable assembly. However due to the individual availability of time and location is different, therefore sometimes it is difficult to organise a meeting that the whole team can attend.

2) Circumstantial Collaboration – "Different Times, Same Place"

Using the notice or bulletin boards is the example of circumstantial collaboration. People may not necessary to meet each other to express their feedbacks as they rely on the medium that passes on information. One of the biggest problems emerged if the relevant parties ignore the notice boards or by chance they miss to see the message. Thus the reliability of this communication channel is low and ineffective.

Least respondents believe the communications that happen at the same place but at different times could succeed in project collaboration. Only the message which is durable and non-critical is advised to use the notice boards, otherwise this method would not be the best way in delivering the urgent or confidential message.

3) Simultaneous Collaboration – "Same Time, Different Places"

The real-time communication that happens at different places is widely adoptive by people who require immediate responses but not physically meeting each other. This is regarded as the contemporary ways of communication with the use of telephony, video conference or electronic group discussion. Assuming both parties have the same type of media or software, then they can communicate wherever they are connected. The advantages of the simultaneous collaboration includes saving travelling time and cost, and accessing instant communication with the right persons. This helps to do the business if the teams are located at different locations which is far to get together.

Different places but same time communication is the most acceptable mean of collaboration according to the research. For sure, this is one of the easiest ways to contact the right person for solving problems or making decisions. With the facilitation of recording services, the conversations could be back-up as for reference or evidence.

4) Remote Collaboration – "Different Times, Different Places"

The less favourable choice is the remote collaboration in which the people communicate via post, fax, voice mail or email, etc. As technology develops, it takes shorter time or even real-time in transmission the message or document. The formal letters and documents sent via post has gradually replaced by email due to lesser cost and time, plus more environmental friendly. However it cannot guarantee whether the right person could pick it up on time and take action as expected, therefore the "different times, different places" is not an ideal method for communications.

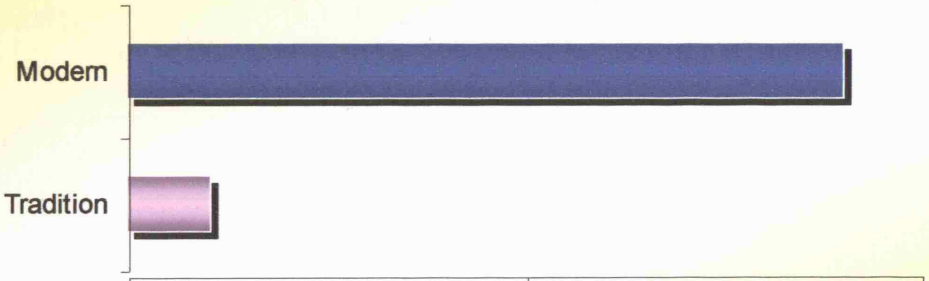
From the research, we can see that the trend of "same time" communication is significant and accordingly the real-time transmission is vital to project collaboration. An additional incentive of project collaboration associates with the existence of the personal contacts. It comes to an agreement that the accessibility of the required person is very importance.

Web-based applications lie across Simultaneous collaboration and Remote collaboration. It depends on user requirements and the extent of services that the suppliers provide. For the advance services that deploy the video conference might help project collaboration in delivering the real-time communication and it heightened the productivity of eventual face-to-face meetings.

The next four questions are very straight forward and it aims to find out the comparisons between two statements that relates to the project collaboration requirements. The results are demonstrated by graph format below (Figure 4.13 to Figure 4.16).

A majority of respondent strongly prefer the modern way of working whereas computer-based system is used (Figure 4.13). This includes the CAD drawings, word processing, computerised project planning programming, electronic sever storage, etc. Only 10% likes better the traditional way of working which is mainly the paper-based system. The trend shows the computerised system is widely adoptive and the developed technology is reliable in replacing the paper documentations.

Figure 4.13 - Tradition vs. Modern way of working

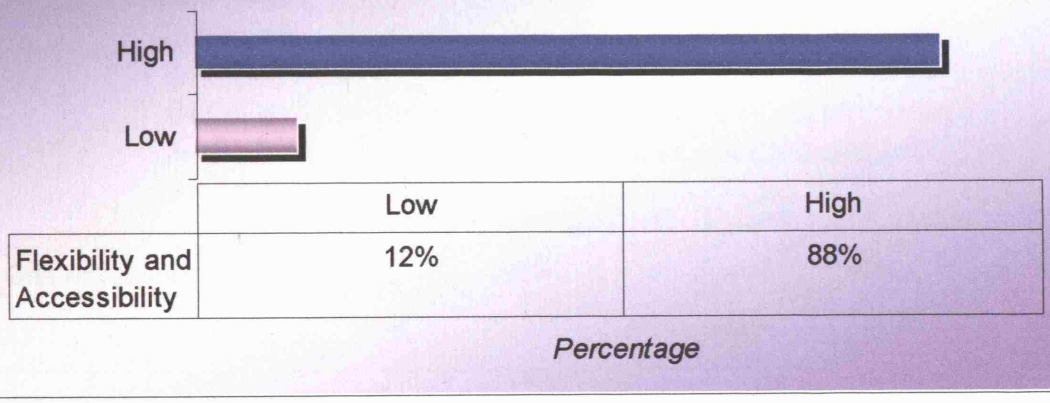


	Tradition	Modern
Way of Working	10%	90%

Percentage

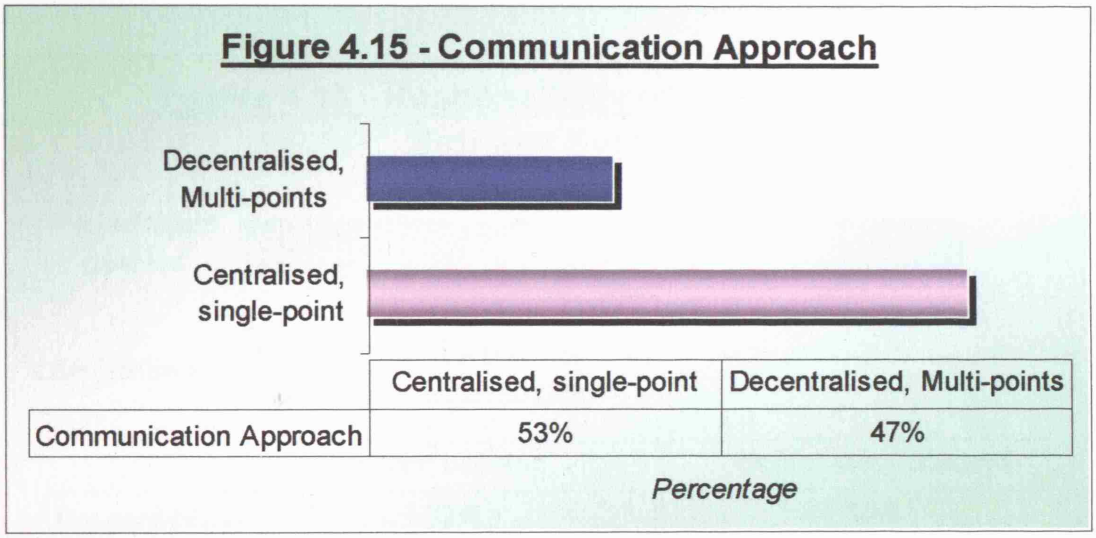
There is no denying that the computerised system and web-based applications enables a high accessibility of documents and even the workforce can access the project information through network or portable PC. As the adoptive level for using computers and online system is higher, referring to the last result, it is no wonder the workforce would prefer taking the advantages of flexible working environment and easy access of documentations at anytime in anywhere (Figure 4.14).

Figure 4.14 - Flexibility and Accessibility of working and documentation



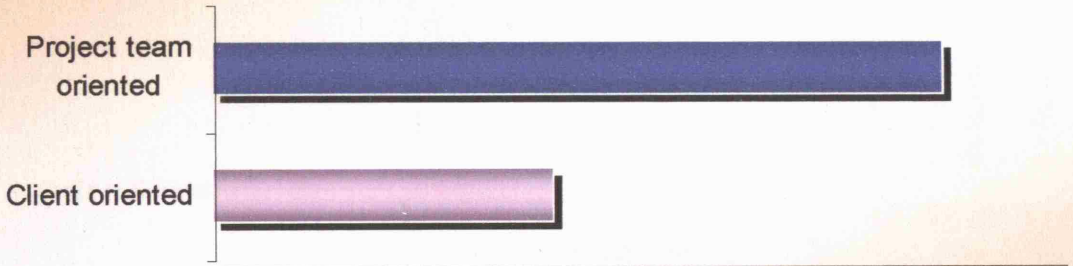
The implementation of web-based applications encourages centralised, single-point communication whereas information is collected in one online database system that can be shared with the team. Although the clear path of communication could help to improve the project collaboration, Figure 4.15 illustrates that respondents are about half-half in deciding on their communication approach.

Figure 4.15 - Communication Approach



Lastly the question aims to identify whether the participants think for which party it should be responsible for the implementation, training and maintaining the Extranet throughout the project delivery stage. The results in Figure 4.16 exemplify 68% of respondents agree the project team should take the responsibility and take the initiative to get involve as far as they are the users. The rest of 38% of respondents thinks it is the client's liability to implement the web-based tool, and therefore the clients should sustain the system.

Figure 4.16 - Responsibility of Maintaining the Extranet System



	Client oriented	Project team oriented
Responsibility	32%	68%

Percentage

4.3 Section 3 of Questionnaire

The method of Likert scaled responses is used in this section. This five-point scale enables the participants to assess their opinions of the statements according to their experience or assumptions. This section aims to find out the influence of modern project collaboration in terms of project and corporate related issues. The result (Figure 4.17) is shown in Matrix format and all the Figure are in percentage.

Figure 4.17 -

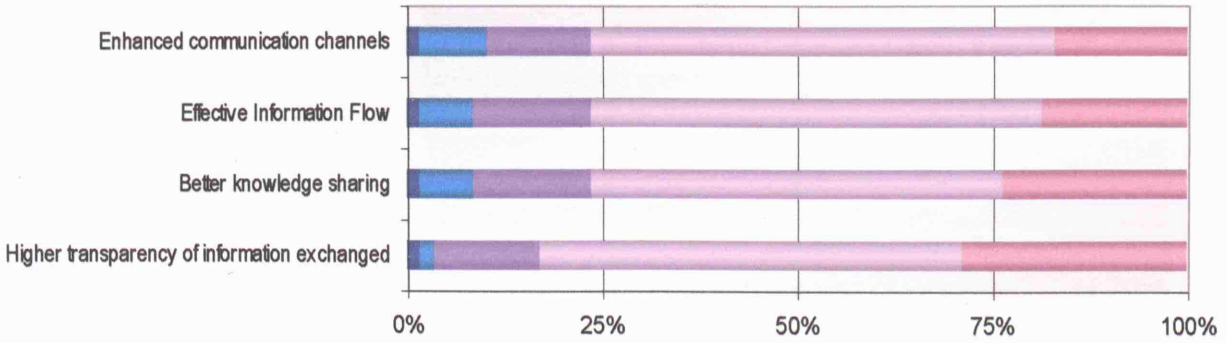
		1 - Strongly disagree	2 - Disagree	3 - Neither agree nor disagree	4 - Agree	5 - Strongly agree
	Project Related :					
14.	Integration of the appropriate technology	1.7	1.7	31.7	55.0	10.0
15.	Better knowledge sharing	1.7	6.7	15.0	53.3	23.3
16.	Effective Information Flow	1.7	6.7	15.0	58.3	18.3
17.	Access to a rich history	1.7	8.3	31.7	43.3	15.0
18.	Promotes best practice	1.7	11.7	38.3	45.0	3.3
19.	Troubleshooting and re-working of designs	1.7	10.0	35.0	48.3	5.0
20.	Enhanced communication channels	1.7	8.3	13.3	60.0	16.7
21.	Time, cost and quality are more certain	1.7	31.7	35.0	25.0	6.7
22.	Better understanding of project team	5.0	20.0	35.0	35.0	5.0
23.	Clearer project organisational structure	3.3	31.7	33.3	26.7	5.0
24.	Increase efficiency and productivity	3.3	13.3	23.3	50.0	10.0
25.	Higher transparency of information exchanged	1.7	1.7	13.3	55.0	28.3
26.	Facilitate decision making	3.3	16.7	35.0	41.7	3.3
27.	Improved co-ordination and accessibility	1.7	5.0	21.7	56.7	15.0
28.	Standardisation of project tools and methods	1.7	5.0	30.0	48.3	15.0
	Corporate Related :					
29.	Improved business relationships	3.3	30.0	38.3	28.3	-
30.	Associates business processes with documents and records	1.7	6.7	35.0	53.3	3.3
31.	More opportunities for partnering	1.7	23.3	53.3	20.0	1.7
32.	Long term benefits to industry	1.7	8.3	26.7	55.0	8.3
33.	Cost savings on document management	5.0	8.3	18.3	45.0	23.3

The statements listed in this section are extracted from different sources and they are supposed the benefits or advantages of the Project Extranet. However the findings illustrate a slightly different perception from the users and non-users in reality. Although there is no right or wrong in explaining the subjective situation, the findings help to define which item requires more development whilst the web-based application is used.

Trends are highlighted in Figure 4.17 (pink represents more than 50% participants, green represents 30% to 50%) which specified the majority reliance of every statement.

According to the results, it shows that the advantage of information transmission is the most successful. Figure 4.18 illustrates over 75% of respondents agreed or strongly agreed the Extranet provides higher transparency of information exchanged and the effective flow of information as the new technology speed the process through online project collaboration. They also believe the communication channel could be improved and the system allows them to have better knowledge sharing.

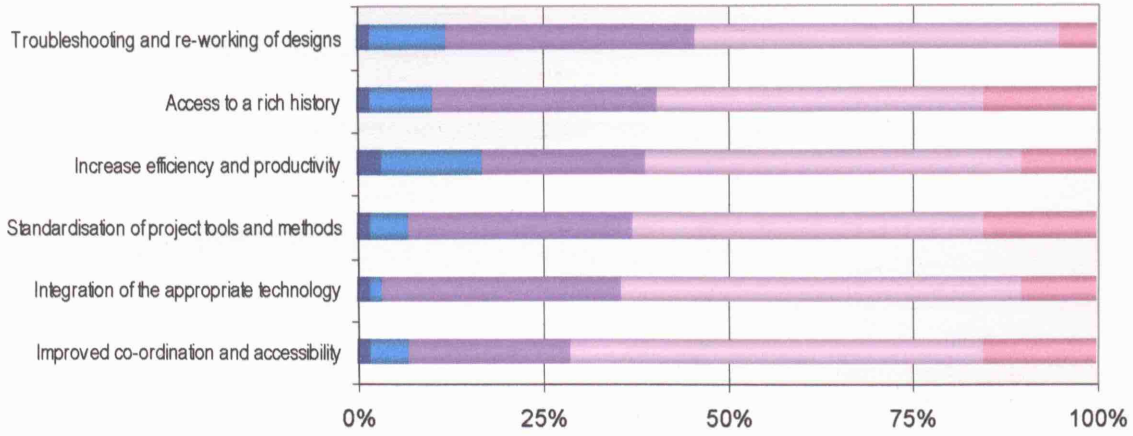
Figure 4.18 - Majority Agree / Stongly Agree



	Higher transparency of information	*Better knowledge sharing*	*Effective Information Flow*	*Enhanced communication channels*
5 - Strongly agree	*28.8*	*23.7*	*18.6*	*16.9*
4 - Agree	*54.2*	*52.5*	*57.6*	*59.3*
3 - Neither agree nor disagree	*13.6*	*15.3*	*15.3*	*13.6*
2 - Disagree	*1.7*	*6.8*	*6.8*	*8.5*
1 - Strongly disagree	*1.7*	*1.7*	*1.7*	*1.7*

On the other hand, as showed in Figure 4.19, more than half participants agreed or strongly agreed that the Extranet would encourage co-ordination within the project team. They also agreed Extranet as the integration of the appropriate technology which comprises the standardisation of project tools and methods. Moreover the Extranet is regarded as the tool for accessing to rich history and troubleshooting and re-working of designs.

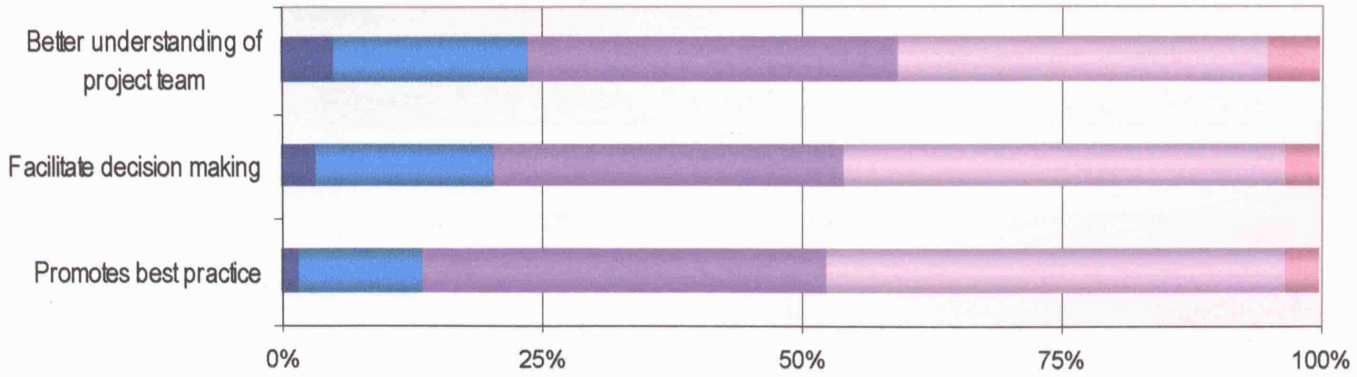
Figure 4.19 - More than Half Agree / Strongly Agree



	Improved co-ordination	Integration of the appropriate	Standardisation of project	Increase efficiency and	Access to a rich history	Troubleshooting and re-working of
5 - Strongly agree	15.3	10.2	15.3	10.2	15.3	5.1
4 - Agree	55.9	54.2	47.5	50.8	44.1	49.2
3 - Neither agree nor disagree	22.0	32.2	30.5	22.0	30.5	33.9
2 - Disagree	5.1	1.7	5.1	13.6	8.5	10.2
1 - Strongly disagree	1.7	1.7	1.7	3.4	1.7	1.7

About 40% to 48% agreed or strongly agreed that the Extranet can promote best practice, facilitate decision making and provides a better understanding of project team. There is also more than one-third of them gave the neutral answer (Figure 4.20).

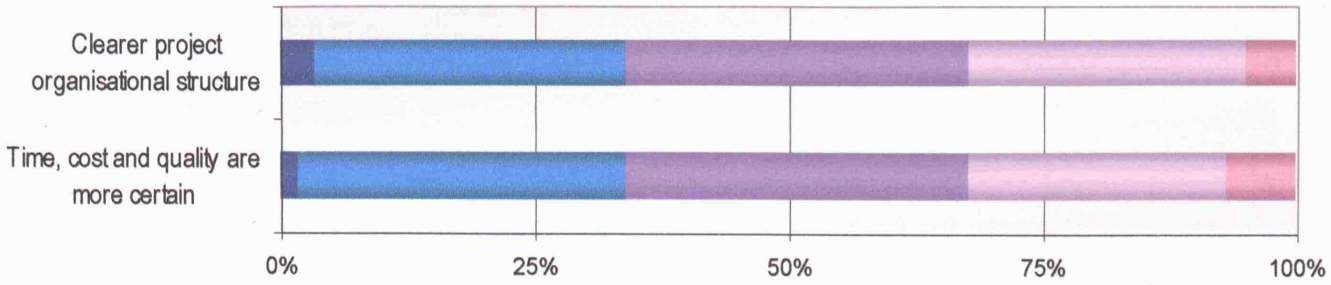
Figure 4.20 - About Half Agree / Neutral



	Promotes best practice	*Facilitate decision making*	*Better understanding of project team*
5 - Strongly agree	*3.4*	*3.4*	*5.1*
4 - Agree	*44.1*	*42.4*	*35.6*
3 - Neither agree nor disagree	*39.0*	*33.9*	*35.6*
2 - Disagree	*11.9*	*16.9*	*18.6*
1 - Strongly disagree	*1.7*	*3.4*	*5.1*

Despite the neutral responses, there is a negative result which shows a slightly more participants disagreed with the statement than the ones who agreed (Figure 4.21). These include the Extranet provides more certainty of time, cost and quality in project delivery, and also the web-based applications can help to identify clearer project organisational structure. Again, about one-third of respondents neither agreed nor disagreed. Some respondents with experiences in web-based applications said that they did not notice any significant changes to the project after the use of Extranet as their ways of working are pretty much the same as before.

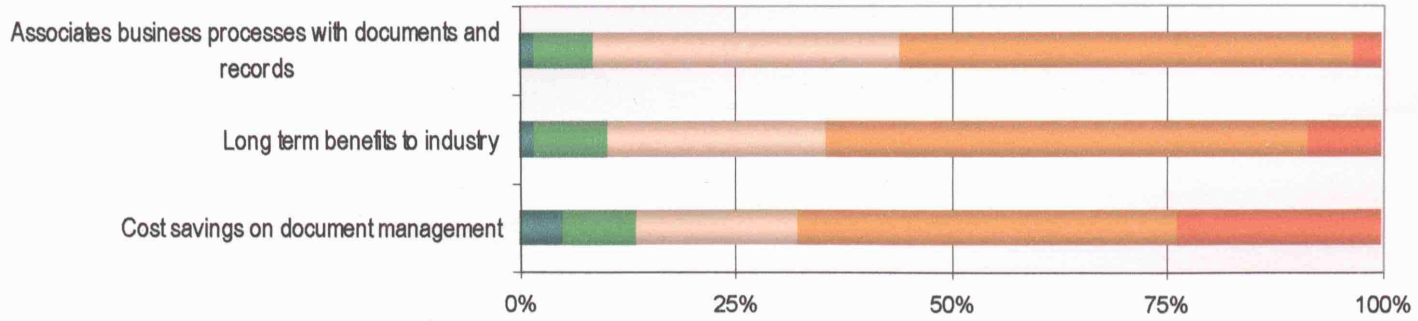
Figure 4.21 - More Participants Disagree than Agree



	Time, cost and quality are more certain	*Clearer project organisational structure*
5 - Strongly agree	*6.8*	*5.1*
4 - Agree	*25.4*	*27.1*
3 - Neither agree nor disagree	*33.9*	*33.9*
2 - Disagree	*32.2*	*30.5*
1 - Strongly disagree	*1.7*	*3.4*

In determining the corporate effectiveness, the result in Figure 4.22demonstrated a positive response on cost savings on document management, long term benefits to industry and associate business processes with documents and records. More than half respondents agreed or strongly agreed the statements, and only 8.5% to 13.6% corresponded to disagree or strongly disagree.

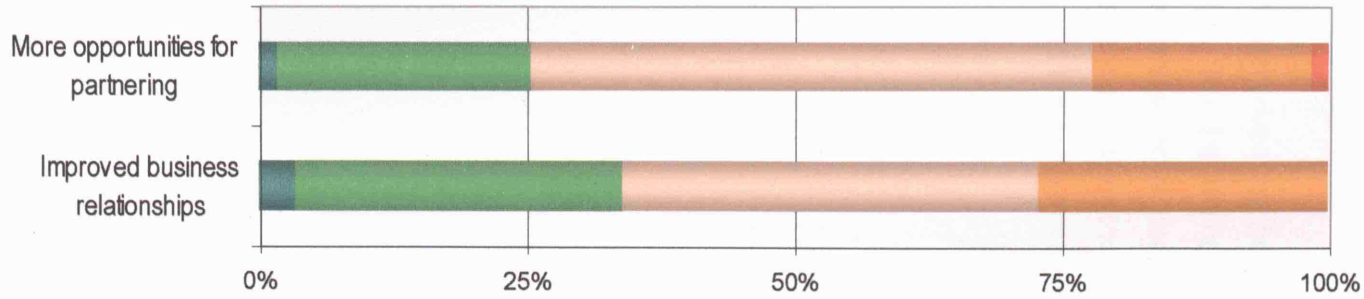
Figure 4.22 - More than Half Agreed / Strongly Agreed



	Cost savings on document management	*Long term benefits to industry*	*Associates business processes with documents and*
5 - Strongly agree	*23.7*	*8.5*	*3.4*
4 - Agree	*44.1*	*55.9*	*52.5*
3 - Neither agree nor disagree	*18.6*	*25.4*	*35.6*
2 - Disagree	*8.5*	*8.5*	*6.8*
1 - Strongly disagree	*5.1*	*1.7*	*1.7*

Surprisingly, no respondent strongly agreed the Extranet could help to improve business relationships (Figure 4.23). Although 27.1% of respondents believe Extranet could help in some ways, a strong voice of 34.5% considered the Extranet could not help to improve the business relationships. On the other hand, about half of respondents neither agreed nor disagreed that the Extranet could create more opportunities for partnering.

Figure 4.23 - More Participants Disagree than Agree



	Improved business relationships	*More opportunities for partnering*
5 - Strongly agree	*-*	*1.7*
4 - Agree	*27.1*	*20.3*
3 - Neither agree nor disagree	*39.0*	*52.5*
2 - Disagree	*30.5*	*23.7*
1 - Strongly disagree	*3.4*	*1.7*

4.4 Summary

The completed questionnaires achieved the principle of this research and the results illustrated a positive responds. The trend shows the implementation of Extranet is expected to grow and it becomes more common in the industry. Due to some outcomes in this section do not match with the hypothesis, therefore the case study in the next chapter will focus and examine the remarkable results.

Chapter 5 - Case Study - Qualitative Research Material

On top of the primary research, a case study of an existing project was carried out to investigate the web-based applications in more depth. Opened questions associated to the motivation of the web-based application to the business outlook were asked in this interview.

Chapter 5

The following is the summary of the interview with Baerbel Schuett, the Project Director of Cyril Sweett Ltd, which highlights the key facts and opinions from her present experience. The full report of the interview is attached in Appendix D.

5.1 Project Background

- Finzels Reach (Courage Brewery site in Bristol) is a mixed-use urban regeneration project involves commercial, residential, retail, leisure, bridge and affordable housing.
- Gross development exceeds £200m with different procurements and contractors.
- Two different project teams – one for the main scheme, another for the affordable housing project.
- Client is the USA developer HDG-Mansur Investment and hence requires access to the project information remotely, especially the project finance issues.
- BIW is appointed as the Extranet provider as their services cover both the online filing, commenting the documents and actions flag-up reminders.
- The cost of services includes installation, training and maintenance of the Extranet till completion of project unless change to the term of contract.

5.2 Advantages of Extranet

- Extranet is used as a process-oriented system in this project to minimise the distance constraints.
- Project management made easier in tracking progress after the web-based application.
- Other advantages include easy and reliable access of updated documents, reduce the quantity of external emails, setting standards and procedures, powerful search engine, etc.

5.3 Disadvantages of Extranet

- Face-to-face meetings still hold regularly to keep the team informed and collaborated and the process has made no different after Extranet is used.
- Business relationship cannot be improved by any mean from the web-based application without the face-to-face meeting because relationship is developed by people not by tool.
- Extranet can help in allocation of tasks and tracking progress but not for decision making.
- In general, the team members are happy to use the Extranet, however not the training session as it takes time.
- Training becomes a problem as the trained staffs left their company before the project finished and the new joiners who take the job are required to take the training course; thus the upfront costs for the training.

- One of the difficulties is that if one of the project stakeholders does not use the Extranet nor use it properly, then the procedure would fail to operate. It is quite often happens on the specialist consultants.
- The complicated interface and procedure makes it difficult to use and upload documents, that is, structured and standardised documentation registry is required for administration and execution.
- Some companies rely on their junior staffs to administrate the system so the senior staffs may have limited knowledge in using it.
- Various Extranet suppliers provide different type of services depends on the functions that the clients require; therefore there is no standardisation of all Extranet interfaces and specific training is needed each time if the next project uses another Extranet provider other than BIW.

5.4 Summary

The drawback of the web-based applications in a typical construction project is perceived. Even though the Extranet could facilitate project management, there are some operational problems that obstruct the full implementation of the system. Team cooperation and direct contact are regarded more important than the application of a tool. Moreover, IT cannot totally replace the traditional collaboration.

Chapter 6 - Limitations of Research

In the primary research, there were 60 responses in answering the questionnaire which is a fair number for the quantitative survey within a short time. However the distribution of the questionnaire is not very balance, so most of the respondents are the construction consultants rather than contractor. It is a pity for no response from developer, as a result we cannot see if there is any contradiction from their point of views.

Chapter 6

6.1 Quantitative Method:

If I am doing the same research again, I would consider taking the same proportion of questionnaires from different categories, that is, consultants, contractors and developers. In this case, we can distinguish the results from a balanced collection of different project roles. On top of that, the profession groups can break down into more details, that is, the selection of "others" in this questionnaire includes health and safety planner, planner supervisor, construction consultants such as expert witness, risk management consultant, etc. or managing directors that they work on different projects rather than focus on one sector. They are possibly working on different types of projects at the same time. Their feedbacks are important; however it adds difficulties to assess the standard of results.

Some people refused to do the questionnaire as they do not know the term "Extranet". They thought if it is a technical term that they never heard of and refused to do the questionnaire. If I slightly change the structure of the questionnaire and raise the questions about the "experience" section at the end of the questionnaire, then the participants may feel more user-friendly and more of them would respond.

In section 3 of the questionnaire, Likert scale was used to distinguish the conformity level of argument. Nevertheless there are many neutral responses which stands for neither agreed nor disagree. It has the range of 13.6% to 52.5% who select the neutral as the answer. Due to the questionnaire is straightforward and it allows multiple-choice answers only rather than express the answers in details. The neutral answers do not state clear the reasons of choice. Also, this section contains 15 questions that used the identical formats and respondents may feel tired to think thoroughly when answering the questions, thus they might repeat select the same choice as previous. On top of that, the five levels of argument offer a variety of options in corresponding to respondents' preference. However in this research, the differentiation of the options between "agree" and "strong agree" is not clearly stated. Therefore three options to identify "agree, neutral and disagree" for this section should be enough.

6.2 Qualitative Method:

In general, the case study was very successful and useful to the whole research. It is because the opened questions enable me to clarify the answers in more details. Furthermore, it gives opportunities to the interviewee to express more about their own experiences and personal advice. I believe if more case studies from different Extranet and non-Extranet users could be carried out for this report, then the research contents would be more precise and controversial for further investigation.

6.3 Summary

Both the quantitative and qualitative researches are optimistic in achieving the results, but improvements could be made to enhance the findings by changing the formats and selectively distribute the questionnaire. So that the results would be more balance and more open opinions could be obtained from the respondents. Likewise, the case study would be even better if two or more projects are assessed.

Chapter 7 - Conclusion and Recommendations

The final chapter brings about the overview of the web-based applications in construction projects. The existing situation associated with the research findings is identified and the possible improvement areas are provided with recommendations to backup the circumstances.

Chapter 7

7.1 Facilitating Information Management

In current practice, the web-based application has both advantages and disadvantages for project collaboration. For the intention of transferring, storing, retrieving and archiving information, the Extranet offers the appropriate system to deal with the information management. The whole system is well-organised for electronic filing and it enhances the process of project management by tracking and accessing the documents and drawings, for example, using the search engine to search the location and registered info of certain reports. Time is saved from the repetitive processes and it benefits the whole project team. The system also enables to store a large amount of information which keeps a rich history of the project. Taken as a whole, the Extranet can be described as a consistent online filing cabinet.

Form both primary and secondary researches, the information management play a key role in project collaboration. It can be clearly seen that the Extranet offers a high level of transparency of information. It allows the real-time transmission of information which satisfies the "time" requirement of project collaboration.

In terms of data usage, the implementation of the Web-based applications was successful. Firstly the material provided by the Extranet was willingly employed by the organisation in fulfilment of its operations. It facilitates the project to minimise the overall duration that spent on exchanging information. Although the approximate time saved is not measured, at least it reduced the risk of time uncertainty within a project. Secondly, the clients who made use of the system are satisfied with the manner that influences their jobs, through the nature of the data provided. This is because the published information keeps the client and project team fully informed from time to time. The transparency of information enhanced the quality for auditing purpose and showed the trust and efforts between the parties.

7.2 Lack of Relationship Growth

The creation of the web-based application aspires to link the relevant data bases into ever more extensive and integrated networks. In this way, the online system was assumed to accelerate project development and promote business relationships between the project stakeholders. However the results from the research indicate the business relationships is not likely to be improved just by the application of the online tool. A strong argument about the business relationship has to be developed by face-to-face meetings which cannot be substituted by other means.

The approach adopted by Pinto (1988) was based on a belief in the benefit of cross-functional cooperation. Initial attempts to improve relationships had failed for reasons unconnected with the technology and more to do with operational and practical development concerns. The difficulties in accomplishing physical proximity and accessibility exist when Extranet is used in form of project collaboration. Imprecise goal of web-based application also confused the individual in completing the tasks. Therefore the Extranet cannot directly improve the project collaboration through the cross-functional cooperation process.

7.3 Tentative Commercial Advantage

From the technical point of views, the system is effectively implemented in satisfying user's demand seeing that the Extranet offers a technically accurate and appropriate solution to the problem at hand. In practical, the medium size project would benefit most from the web-based application. This is because the small project, that perhaps only a few people involve, would not need an additional media for information exchange or information management. Otherwise it will take more time in uploading the documents to the Extranet and the whole project would take long time to complete than usual. Moreover the initial set up, maintenance and training fees might add unnecessary costs to the project but bring no added value to team collaboration.

When the project organisations decided to use Extranet, it is essential to state clear who is paying for it in a commercial perspective. If the client is liable for the application, then the project team needs to be to clear as to the advantages this will deliver to him. Also a formal business case is required to be made. As a buyer or end-user of the Extranet, organisational effectiveness would be their target. Therefore clear commercial benefits such as transparent information and speedy transfer are attractive in adopting the new application. However those benefits may not solve the actual organisational problems. For example, the hidden costs of training may be over the buyer's budget. Also, there is a contract between the Extranet provider and buyer, but there is not a contract between the Extranet and end-user. Thus, a professional practical application of Extranet is less certain.

7.4 Trend of Cultural Changes in Industry

Most respondents in the research believed the web-based application would be the new trend in the construction industry. However the implementation requires a cultural mindset change in the industry and a high level of technical expertise will be needed to support the process. There is a concern of whether the system can be sufficiently user friendly so that the average builder, trade contractor and inspector can easily use it. If the Extranet works properly, not only the team would work more effectively, the system can also uses for knowledge management which could enhance the collaboration and establish a good communication network. The implementation of Extranet would take a long time before a high adoption from the industry.

If the web-based application in the construction projects succeeds, then the whole industry will benefit from the increased and improved overall productivity. Once the Extranet becomes more popular and common in use in construction projects, subsequently the individuals and organisations may require lesser proper trainings than before. As the result, the cost would hopefully drops to meet the client's demand.

7.5 Recommendations:

7.5.1 System enhancement

In Chapter 4 and 5, the research result shows the Extranet does not totally fulfil the requirements for project collaboration due to the system cannot overcome or replace the "direct interpersonal contact" issue. Therefore the web-based application is yet to be developed until its benefits for project collaboration could be well defined.

Implementation of a new technology would take a long time before full adoption. Therefore I would recommend if the web-based applications could be made into a faster and simpler tool that would only require little or even no formal training. So that Extranet could be introduced as a user-friendly interface together with online help or hotline supports. The simpler applications would definitely be more appreciated by senior management staffs who occasionally need quick access to obtain information. Also the true collaboration comes through use of commenting, mark-up and other communication features but not just sharing the files.

Extranet should apply the system step by step rather than using very advanced technology. Due to the nature of the industry is rather labour-oriented than machine-orientated, consequently taking up a new technology is slow in the construction sector. Suppliers should consider and understand the client's demand and end-user's requirement. A provision of product with a wider coverage including the small projects would give more contributions to the industry.

The research in this report hinted the current Extranet does not give clear directions in benefiting the project in both cost and quality. These are the areas that the Extranet could certainty be improved. It seems only the large projects could able to afford the cost of web-based application; otherwise it would be an extra investment for the smaller projects without foreseeable returns. The conditions could get better if partnership is well developed in the industry, then the higher certainty of supply chain will reduce the unnecessary cost due to economies of scale. The repeated business between the project organisation and Extranet supplier could establish more favourable terms and internal training can be taken to save the direct cost.

As has become apparent, the Extranet will have a wider market in sooner future and more projects would make use of it for facilitating the project management. Because of the web-based applications would become more common, more skilled labours are required in the construction industry and education of IT plus Extranet should be widely adopted. This could help the industry to move forward and achieve the best result from making use of new technology. Thus the goal for project collaboration is likely to be attained through the majority of workforce rather than individual expertise.

As mentioned in the Egan Report (1998) that the construction industry urges standardisation to solve the long-lasting fragmentation problem, however a big question mark of whether the Extranet is narrower the gaps between the companies or vice versa in future is concerned. This is because there are many ASP existing in the market and all of their products are differently set up. As a result, it puts more pressure to the industry and organisations to take in. Therefore standardisation of the Extranet system is required. This could be executed by the chartered institutes or construction knowledge bodies. In this way, it would help to contribute the industry in achieving better quality for project delivery.

7.5.2 Organisation encouragement

Considering the change and adoption of the Extranet is becoming more common, the project organisations need to understand the capabilities of the technology and its effectiveness. Although many different Extranets exist in the market, the project mangers or buyers ought to identify its business advantages before decide which one to take. Encouragement is important to make things happen; therefore all companies need to take the initiative to convince their staffs to use the Extranet and support their training if required. These recommendations relate to the interactive effects and complementary effects (Hakansson, 1987). However the industry should be aware of the web-based applications are industry-led rather than technology-led. Otherwise the end-users would reject the applications and the overall scheme will fail.

The research indicates about a third of the respondents do not have the experience in their present projects and many of them are working on the health sector projects and some other public sector projects. This may be due to the budget is tighter than the commercial projects and most of these projects only involve in-house resources and therefore they do not require an Extranet for collaboration of team.

In fact the PFI (Private Finance Initiative) health projects could make use of the Extranet in delivering the commissioning project. The Extranet could be procured by the Capital Investment Directorate on behalf of the Trust and accessed by the contractor, corporate stakeholders, Trust management board, commissioning project team and hospital department heads. For that reason, the contractors can pass on the completion of building information together with the variation works progress. Whilst the commissioning team can combine with the information provided to plan about the commissioning process and work with the corporate stakeholders including the IT, telephony, facility management and medical physics, etc. The Extranet can also keep a full history of the project information consists of the building drawings, ADB (Activity Database), construction process and progress throughout the period. The end-users of the hospital departments can then obtain the latest floor plans, move schedule, move policy and procedure documents for their departmental preparation. The web-based application would then save the time in setting up the meeting between the parties if the meeting is only for distributing the latest information instead of discussing outstanding issues. In this way, the web-based applications can bring together the contractors, developer, stakeholders and end-users together in using a single communication and filing system; thus the PFI project delivery would become more achievable in terms of time, cost and quality.

7.5 Summary

To conclude, there is no denying that the web-based application has brought advantages to project collaboration by providing an electronic platform for information and knowledge exchange. Nevertheless, up-take by the industry has been slow and it takes time to go through the changes in replacing the traditional way of working. Efforts are required from all participants including the project organisations and individuals to accomplish their mutual goals and encourage project collaboration. We should gain from using the tool, but not from debating the technology. On the other hand, if the public sector projects may consider to use the web-based application, they could possibly able to enhance their project delivery and more certainty in project completion.

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Appendix A

Appendix A – Questionnaire Template

Appendix A

Questionnaire for Dissertation Research

Topic: Modern Project Collaboration: Web-Based Application in Construction

Section 1 : Web Based Application from Your Experience

Please select your answer here.

1. How well do you know about Extranet ?
2. If so, how many project you work on involves using the Extranet ? (present and past)
3. Do you think if Extranet would become more common in future ?
4. Why you agree Extranet would become more common later ?
5. If the Extranet applies to your project, will you think that could help to improve project delivery ?
6. What do you recognise that the project could be to improve with the application of Extranet ?
7. Are you happy to use Extranets on future projects ?

Section 2 : Project Collaboration Requirements

(Please choose ONE ONLY that you think it is more essential for project collaboration)

either....or.....

8. - Face-to-face meeting / - Communication via post, fax, voice mail, email, etc.
9. - Use notice / bulletin boards within an organisation / - Use telephony, video conference, electronic group discussion / editing facilities
10. - Traditional way of working, i.e. paper-based system / - Modern way of working, i.e. computer-based system
11. - Documents should be accessed at the work place within normal hours / - Flexible access of documents even out of office or beyond official working hours
12. - Centralised, single-point communication approach / - Decentralised, multi-points communication approach
13. - Client is liable to provide the system and training that uses for project delivery / - Project team is responsible for using and learning the project delivery system

Section 3 : The Influence of Modern Project Collaboration

To what extent do you find the web-based applications in project has changed the followings ?

Please rate from 1 to 5 (1=strongly disagree, 5=strongly agree)

Project Related :

14. - Integration of the appropriate technology
15. - Better knowledge sharing
16. - Effective Information Flow
17. - Access to a rich history
18. - Promotes best practice
19. - Troubleshooting and re-working of designs
20. - Enhanced communication channels
21. - Time, cost and quality are more certain
22. - Better understanding of project team
23. - Clearer project organisational structure
24. - Increase efficiency and productivity
25. - Higher transparency of information exchanged
26. - Facilitate decision making
27. - Improved co-ordination and accessibility
28. - Standardisation of project tools and methods

Corporate Related :

29. - Improved business relationships
30. - Associates business processes with documents and records
31. - More opportunities for partnering
32. - Long term benefits to industry
33. - Cost savings on document management

Section 4 : About yourself

34. Are you a ...
35. Your age group is :
36. Which one is the best to describe your organisation ?
37. Which is the major sector of the projects you are involving ?
38. What is the average project cost of your recent projects ?

~ This is the end of the questionnaire. Thank you very much for your precious time. ~

If you would like to see the final result of the research, please tick this box. ☐

Appendix B – Multiple Choice Options

Appendix B

Question Number	*Options*	*Score*
Section 1 : Web Based Application from Your Experience		
1	- Very familiar, I used it before	1
	- I find it difficult to use	2
	- I only heard of the name	3
	- No idea of what is Extranet	4
2	- None	1
	- One to five	2
	- More than five	3
3, 5 & 7	- Yes, certainly	1
	- Maybe	2
	- I don't think so	3
4	- Technology develops too fast	1
	- Affordable cost is a main concern	2
	- Its beneficial level	3
	- The way that may change the industry culture	4
	- None of the above	5
6	- Time	1
	- Cost	2
	- Quality	3
	- All of the above	4
	- None of the above	5
Section 2 : Project Collaboration Requirements		
8.	- Face-to-face meeting	1
	- Communication via post, fax, voice mail, email, etc.	2
9.	- Use notice / bulletin boards within an organisation	3
	- Use telephony, video conference, electronic group discussion / editing facilities	4
10.	- Traditional way of working, i.e. paper-based system	1
	- Modern way of working, i.e. computer-based system	2
11.	- Documents should be accessed at the work place within normal hours	3
	- Flexible access of documents even out of office or beyond official working hours	4
12.	- Centralised, single-point communication approach	1
	- Decentralised, multi-points communication approach	2
13.	- Client is liable to provide the system and training that uses for project delivery	1
	- Project team is responsible for using and learning the project delivery system	2

Question Number	*Options*	*Score*
Section 3 : The Influence of Modern Project Collaboration		
14 - 33	1 - Strongly disagree	*1*
	2 - Disagree	*2*
	3 - Neither agree nor disagree	*3*
	4 - Agree	*4*
	5 - Strongly agree	*5*
Section 4 : About yourself		
34	- Project Manager	*1*
	- Cost Consultant	*2*
	- Architect	*3*
	- Engineer	*4*
	- Others	*5*
35	Under 25	*1*
	25 - 35	*2*
	35 - 50	*3*
	above 50	*4*
36	- Developer / Project Sponsor	*1*
	- Consultants	*2*
	- Contractor	*3*
	- Others	*4*
37	- Education	*2*
	- Health	*3*
	- Infrastructure	*4*
	- Leisure	*5*
	- PPP / PFI	*6*
	- Residential	*7*
	- Retail	*8*
	- Transportation	*9*
	- Others	*10*
38	- under £1m	*1*
	- £1m to £10m	*2*
	- £10m to £50m	*3*
	- above £50m	*4*

Appendix C – Respondent Score Sheet and Results

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Question Number	Ahmed, Shabber	Ball, Stuart	Brand, Kevin	Burrows, Paul	Chan, Alice	Chan, Kitty	Chiu, Kan Chi	Chrysaphides, Paul	Collins, Chris	Cordery, Toby	Crawford, Neil	Crossland, Paul	Doyle, Tom Doyle	Ellis, Carley	Fairbrother, Tim
Section 1	1	1	3	1	1	3	2	4	3	4	1	1	1	1	1	3
	2	1	1	2	1	1	2	1	1	1	3	2	3	2	2	2
	3	1	1	1	1	1	1	3	2	2	1	1	1	1	1	2
	4	1	3	4	4	4	3	5	4	5	3	4	4	4	4	3
	5	1	2	1	3	1	2	3	2	2	1	2	2	2	1	2
	6	4	5	4	4	1	1	4	4	5	4	5	1	4	1	4
	7	1	1	1	1	1	1	3	2	2	1	1	2	1	1	1
Section 2	8	2	1	1	2	2	1	2	1	2	1	1	1	2	1	1
	9	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	10	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2
	11	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4
	12	2	1	2	2	1	1	2	2	1	1	2	1	2	1	2
	13	2	2	2	2	2	2	2	2	2	2	2	1	1	1	2
Section 3	14	5	4	4	4	5	3	1	3	3	4	3	4	3	5	4
	15	5	3	5	3	2	3	1	4	3	4	3	3	4	5	4
	16	5	4	4	4	5	4	1	4	3	4	4	2	5	5	4
	17	5	4	4	3	4	2	1	4	3	4	4	4	4	5	4
	18	4	4	4	2	2	4	1	3	3	3	3	3	3	5	3
	19	4	4	3	2	3	3	1	3	3	3	3	4	5	5	3
	20	5	4	4	4	2	4	1	4	3	4	4	2	5	5	4
	21	5	3	5	2	2	3	1	3	3	3	3	3	3	4	4
	22	4	2	5	2	4	3	1	3	3	4	4	2	3	3	3
	23	3	4	5	2	2	2	1	3	3	3	4	2	4	3	3
	24	3	3	5	4	2	4	1	2	3	4	3	2	4	5	3
	25	5	4	4	4	5	3	1	4	3	5	5	4	4	5	4
	26	4	4	5	3	2	3	1	3	3	4	4	3	4	3	4
	27	5	3	4	4	2	4	1	3	3	4	4	3	4	5	5
	28	3	4	4	4	2	3	1	4	3	3	4	4	4	5	4
	29	4	3	4	2	1	2	1	3	3	3	2	2	2	3	4
	30	5	3	3	2	3	3	1	3	3	4	3	4	4	4	3
	31	5	3	4	2	2	2	1	3	3	3	3	4	2	3	3
	32	5	3	5	3	4	4	1	4	3	4	4	4	2	3	4
	33	5	4	5	4	2	4	1	4	3	4	3	4	4	5	4
Section 4	34	1	1	1	5	1	1	2	1	2	1	1	5	1	1	5
	35	2	2	2	3	2	2	1	3	2	2	2	3	2	2	2
	36	4	2	2	2	2	3	2	2	2	2	2	2	3	2	1
	37	3	10	7	10	3	6	3	8	8	8	8	10	6	10	3
	38	4	2	3	1	3	4	3	2	4	3	2	3	3	3	4

Appendix C

		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	Question Number	Gandonu, Soyingbe	George, Jane	Gillespie, Victor	Graham, Paul	Green, Stephen	Hart, Sarah	Heffernan, Derek	Held, Christian	Ho, Clement	Hong, Ong	Ian Lloyd, Ian	Jacquemin, Muriel	Jones, Chris	Kan, Chrystele	Kelly, John
Section 1	**1**	3	1	3	1	1	2	1	1	3	1	3	4	3	3	4
	2	1	2	1	2	3	2	2	2	2	2	1	1	2	2	1
	3	1	1	2	2	1	2	2	1	1	2	2	2	1	2	2
	4	1	3	5	5	2	3	4	5	3	1	5	3	3	2	5
	5	1	2	2	3	1	2	2	1	2	2	2	3	1	1	3
	6	1	4	4	5	2	4	1	3	2	1	4	4	1	4	5
	7	1	2	2	1	1	2	1	1	2	2	2	1	1	2	3
Section 2	**8**	2	1	2	1	2	1	1	1	1	2	1	1	1	1	2
	9	4	3	4	4	4	4	3	4	4	3	4	4	4	4	4
	10	2	2	2	0	2	2	2	2	2	1	1	2	2	2	2
	11	4	4	4	0	4	4	4	4	4	4	3	4	4	4	4
	12	2	1	1	0	1	2	2	1	2	1	1	2	1	1	2
	13	1	1	1	2	2	2	2	2	1	2	2	2	2	1	1
Section 3	**14**	4	4	4	3	4	4	4	3	4	4	4	4	4	4	3
	15	4	4	4	2	4	4	4	3	5	4	4	5	5	5	4
	16	4	3	4	2	5	4	3	3	5	4	4	3	3	5	4
	17	4	4	2	3	3	3	3	3	4	4	4	4	4	5	4
	18	4	3	2	2	2	4	4	4	4	4	4	4	4	4	3
	19	4	3	4	3	4	3	3	4	3	4	4	4	3	4	2
	20	4	4	5	3	4	4	4	4	4	4	3	4	2	4	4
	21	4	3	4	2	3	3	2	2	2	4	3	4	4	4	2
	22	4	4	2	3	4	2	3	2	3	4	3	3	2	3	3
	23	4	3	2	3	4	4	3	2	2	4	2	3	4	2	2
	24	4	4	4	2	4	3	3	4	2	4	3	3	4	4	3
	25	4	5	4	4	4	4	4	4	3	4	3	4	5	3	3
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	27	4	4	4	3	4	4	3	4	3	4	3	4	4	4	3
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	29	4	3	2	2	2	4	3	3	2	4	3	2	2	3	2
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	31	4	3	3	3	3	3	3	2	3	4	3	3	3	3	3
	32	4	3	4	3	4	3	3	4	3	4	3	4	4	3	2
	33	4	4	4	3	4	4	4	5	3	4	3	5	4	1	2
Section 4	**34**	1	2	2	1	1	1	1	3	5	4	2	1	1	2	2
	35	2	3	4	3	3	2	2	2	2	2	2	2	2	2	3
	36	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	37	7	8	6	8	8	3	8	2	9	7	5	3	2	2	3
	38	3	4	3	4	1	3	4	3	1	3	3	4	3	2	3

Appendix C

		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
	Question Number	Kemp, Sue	Langford, Neil	Lastra, Macros	Lee, Lawrence	Leung, Quentin	Mackrell, Neil	Manship, Conel	Marlow, Paul	McCarthy, Peter	Moebeek, Martijn	Ngai, Tony	Nguyen, Simon	Obeime, Dermot	Parsons, Javier	Patel, Ketan
Section 1	**1**	1	1	1	4	4	1	1	1	1	1	1	1	4	3	2
	2	2	2	2	1	1	2	2	2	3	2	2	2	1	1	2
	3	1	2	1	2	3	1	2	1	1	1	1	1	2	1	2
	4	4	2	4	4	2	2	5	4	3	3	2	2	4	3	3
	5	2	2	1	2	3	1	2	1	1	2	1	1	3	1	2
	6	2	1	1	4	4	1	1	4	4	3	4	1	1	4	3
	7	2	2	1	2	2	1	1	1	1	2	1	1	3	1	2
Section 2	**8**	1	1	1	1	2	2	2	1	2	1	1	1	1	2	2
	9	4	4	4	4	4	4	4	4	3	4	4	4	3	4	3
	10	2	2	2	2	2	2	2	2	1	2	2	2	1	2	2
	11	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3
	12	2	2	2	1	2	1	1	2	2	2	2	1	1	1	1
	13	2	1	2	2	2	2	1	1	1	2	2	1	2	2	1
Section 3	**14**	3	5	4	4	3	4	3	3	3	4	4	5	4	4	3
	15	4	4	3	4	5	5	4	4	4	5	4	5	5	4	4
	16	4	4	4	4	4	5	4	4	5	4	4	5	4	4	3
	17	3	3	3	4	4	5	3	5	5	3	4	5	2	4	3
	18	4	3	3	3	4	4	3	3	3	4	4	5	3	4	4
	19	4	4	4	4	4	4	4	2	4	3	4	5	3	4	4
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	30	2	3	4	4	4	3	2	4	4	4	4	4	4	4	3
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	32	3	4	4	4	4	5	3	4	4	4	4	3	2	5	4
	33	3	2	5	5	4	5	3	5	4	4	4	5	5	5	3
Section 4	**34**	1	2	3	4	4	2	2	1	3	1	4	1	5	2	5
	35	4	2	2	2	2	2	3	3	1	2	2	3	3	2	2
	36	4	2	4	2	2	2	2	2	2	2	2	2	2	2	4
	37	3	2	7	9	9	8	3	10	8	10	4	10	10	6	10
	38	1	2	1	4	3	4	4	3	2	2	1	4	1	3	2

		46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
	Question Number	Pickering, Helen	Robbins, Andrew	Rowland, Martin	Schuett, Baerbel	Tan, Angie	Tan, Cheen Koon	Trevena, Steve	Varinder, Atwal	Wadeson, Tony	Wang, Richard	White, Duncan	Wilson, Michael	Woolcock, Patrick	Yarranton, Matthew	Young, Mary
Section 1	1	2	1	1	1	1	2	1	1	1	1	1	1	1	3	3
	2	2	2	2	2	2	2	2	2	2	2	1	2	3	1	1
	3	1	1	1	1	1	2	1	1	1	1	1	1	1	2	2
	4	3	5	4	5	4	3	5	1	4	1	4	4	4	4	2
	5	1	2	1	1	1	2	1	2	1	1	2	2	1	2	2
	6	4	1	5	4	1	5	1	1	4	1	1	1	4	5	3
	7	1	1	2	1	1	2	1	1	1	1	1	1	2	2	1
Section 2	8	1	1	1	1	1	2	2	1	1	1	1	2	2	1	2
	9	4	4	4	4	4	4	4	4	4	3	3	3	4	4	4
	10	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2
	11	4	4	4	4	4	3	4	4	4	4	4	4	3	3	4
	12	1	2	2	1	1	1	1	1	2	1	2	1	2	2	1
	13	2	2	1	2	2	2	2	1	1	2	2	1	2	2	2
Section 3	14	4	4	3	3	3	4	3	4	4	5	2	4	4	3	4
	15	5	4	4	4	4	4	4	4	4	2	2	5	4	4	3
	16	4	4	4	4	5	4	4	3	4	2	2	3	4	4	4
	17	2	3	5	4	4	3	4	2	3	5	4	3	4	3	3
	18	4	4	3	3	3	3	3	4	3	2	4	3	4	2	4
	19	4	4	3	3	3	2	3	2	4	2	4	4	4	3	4
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	21	4	4	2	3	5	2	2	2	3	2	2	3	5	3	2
	22	2	4	3	3	5	4	2	1	3	4	1	4	4	2	3
	23	3	3	2	3	3	2	2	2	3	5	1	4	3	3	2
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	32	4	4	4	4	4	3	4	4	4	2	2	3	5	4	4
	33	4	3	3	4	5	2	4	5	4	2	1	3	4	4	4
Section 4	34	1	1	1	1	2	2	2	2	2	3	1	5	3	2	2
	35	2	2	3	3	2	2	2	1	3	2	4	3	1	2	2
	36	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2
	37	3	6	7	10	8	6	8	8	10	8	3	8	8	2	7
	38	3	3	2	3	4	4	4	1	3	3	1	4	4	2	2

Section 1 : Web Based Application from Your Experience		Number of Respondents
1. How well do you know about Extranet ?	- Very familiar, I used it before	35
	- I find it difficult to use	5
	- I only heard of the name	13
	- No idea of what is Extranet	7
2. If so, how many project you work on involves using the Extranet ? (present and past)	- None	19
	- One to five	36
	- More than five	5
3. Do you think if Extranet would become more common in future ?	- Yes, certainly	38
	- Maybe	20
	- I don't think so	2
4. Why you agree Extranet would become more common later ?	- Technology develops too fast	5
	- Affordable cost is a main concern	8
	- Its beneficial level	15
	- The way that may change the industry culture	21
	- None of the above	11
5. If the Extranet applies to your project, will you think that could help to improve project delivery ?	- Yes, certainly	25
	- Maybe	28
	- I don't think so	7
6. What do you recognise that the project could be to improve with the application of Extranet ?	- Time	21
	- Cost	3
	- Quality	4
	- All of the above	24
	- None of the above	8
7. Are you happy to use Extranets on future projects ?	- Yes, certainly	37
	- Maybe	20
	- I don't think so	3

Section 2 : Project Collaboration Requirements

(Please choose ONE ONLY that you think it is more essential for project collaboration)

		Number of Respondents
8.	- Face-to-face meeting	38
	- Communication via post, fax, voice mail, email, etc.	22
9.	- Use notice / bulletin boards within an organisation	9
	- Use telephony, video conference, electronic group discussion / editing facilities	51
10.	- Traditional way of working, i.e. paper-based system	6
	- Modern way of working, i.e. computer-based system	53
11.	- Documents should be accessed at the work place within normal hours	7
	- Flexible access of documents even out of office or beyond official working hours	52
12.	- Centralised, single-point communication approach	31
	- Decentralised, multi-points communication approach	28
13.	- Client is liable to provide the system and training that uses for project delivery	19
	- Project team is responsible for using and learning the project delivery system	41

Section 3 : The Influence of Modern Project Collaboration						
		1 - Strongly disagree	2 - Disagree	3 - Neither agree nor disagree	4 - Agree	5 - Strongly agree
	Project Related :					
14.	Integration of the appropriate technology	3	1	19	33	6
15.	Better knowledge sharing	2	4	9	33	14
16.	Effective Information Flow	2	4	9	36	11
17.	Access to a rich history	2	5	19	26	10
18.	Promotes best practice	2	7	23	27	2
19.	Troubleshooting and re-working of designs	2	6	21	29	3
20.	Enhanced communication channels	2	5	8	36	11
21.	Time, cost and quality are more certain	2	19	21	15	4
22.	Better understanding of project team	3	12	22	21	3
23.	Clearer project organisational structure	2	20	20	16	3
24.	Increase efficiency and productivity	2	9	14	30	6
25.	Higher transparency of information exchanged	3	1	8	33	17
26.	Facilitate decision making	2	11	21	25	2
27.	Improved co-ordination and accessibility	2	3	14	34	9
28.	Standardisation of project tools and methods	2	3	19	29	9

Section 3 : The Influence of Modern Project Collaboration						
		1 - Strongly disagree	2 - Disagree	3 - Neither agree nor disagree	4 - Agree	5 - Strongly agree
	Corporate Related :					
29.	Improved business relationships	2	19	23	17	0
30.	ates business processes with documents and records	2	4	21	33	2
31.	More opportunities for partnering	2	14	32	12	1
32.	Long term benefits to industry	2	5	16	33	6
33.	Cost savings on document management	3	5	12	27	15

Section 4 : About yourself

			Number of Respondents
34.	Are you a ...	- Project Manager	26
		- Cost Consultant	18
		- Architect	5
		- Engineer	4
		- Others	7
35.	Your age group is :	- Under 25	4
		- 25 to 35	38
		- 35 to 50	15
		- above 50	3
36.	Which one is the best to describe your organisation ?	- Developer / Project Sponsor	1
		- Consultants	51
		- Contractor	3
		- Others	5
37.	Which is the major sector of the projects you are involving ?	- Education	5
		- Health	11
		- Infrastructure	1
		- Leisure	1
		- PPP / PFI	6
		- Residential	6
		- Retail	16
		- Transportation	3
		- Others	11
38.	What is the average project cost of your recent projects ?	- under £1m	9
		- £1m to £10m	11
		- £10m to £50m	23
		- above £50m	17

Appendix D

Appendix D – Interview Report

Appendix D

Case Study – Qualitative Research Material

The following questions are prepared as the contents for the interview:

- **Background**: size, project value, client, nature, business sector, scope of work, procurement, project organisation structure
- What is the **objective** of the web-based application?
- What is the **motivation** in using the new tool?
- Is there any **risk** assessment / risk management to ensure things go alright in case the system failed?
- Do you think if all other projects (size, value, type) can **adopt** the extranet? If no, what are the **constraints**?
- What are the key **advantages** in using the project extranet (both **short term and long term**)?
- How can it bring **benefits to both project and corporate**?
- What are the **responses** from client, project team and contractor?
- What are the **differences** in ways of working, co-ordination, teamwork, knowledge sharing, project management?
- How do the extranet **help the project manager**?
- At **what stage** of the construction project is the best time for set up / implement the extranet?
- What are the **attitudes of the project team** when the extranet is first implemented?
- Do they (project team) **realise the functions and benefits** of extranet before they use or they are advised to use it?
- Are they all **happy** in using it and go to the training as required?
- What are **problems** throughout the stages?
- What are the **solutions**?
- How much is the "**cost**" (including setup, training, maintenance)? Percentage in project value? Does it take long time to recover the cost?
- Was it a **successful** application?
- What are the **lessons learnt** from the web-based application in your project?
- From the survey, some problems come out, more people DISAGREED the following than agreed, what could be the **reasons** behind?
    1) *Time, cost and quality are more certain*
    2) *Clearer project organisational structure*
    3) *Improve business relationships*
    4) *More opportunities for partnering*

Case Study – Qualitative Research Material

Topic:	A case study of a current project that uses the Extranet
Interviewee:	Baerbel Schuett (Project Director of Cyril Sweett Ltd)
Date:	10 August 2005
Time:	5pm
Venue:	Cyril Sweett Ltd., Gray's Inn Road Head office
Project Name:	Finzels Reach
Client:	HDG-Mansur Investment
Extranet Provider:	BIW

AK = Amy Kam (Interviewer)

BS = Baerbel Schuett (Interviewee)

AK: Baerbel, could you please talk about some of the backgrounds about the project that you use the Extranet? Such as the nature, size, procurement of the project.

BS: The Finzels Reach project (Courage Brewery site in Bristol) is a mixed-use, commercial, residential, a bit retail, health club, leisure, retail, bridge: also a link project of the affordable housing on the other side; Extranet allow to access both projects, same client, different project different team, i.e. different architect but link to project because need to provide developer information; construction cost over £100m, different procurements for different function of building, include D&B, two-stage, etc. Design team is the same for the project but different contractor.

AK: Is this the first time you use the Extranet? If not, how many times have you used it before?

BS: Yes, this is my first time in using the extranet. I found it very useful but unfortunately not yet seeing the construction phases, useful in exchanging information, team co-ordination was good but still have meetings to review drawings, etc regularly, It is not totally remote. Frequency of face-to-face meeting hasn't gone down; extranet does not replace the face-to-face meeting.

Appendix D

AK: **What are the differences in the ways of working?**

BS: Way of working is different due to reduction of email and correspondence, amount of emails that received has been reduced, documentation are loaded to the extranet system for the team to review and comment, they have to select actions for who to review, who to take actions, who is for information; all the extranet systems are different and the functions depend on which extranet system is used.

AK: **How about co-ordination and teamwork? Any significant changes?**

BS: teamwork and knowledge sharing, not much changing different because face-to-face meeting still happening

AK: **What are the main benefits that you find the Extranet could facilitate?**

BS: Benefits for people particular working with client or people who are remote or sit in the space or somewhere else, if they can access internet, pick up the file and can comment from where they are and they don't need any special software as they can view the drawings or documents by using the PDF viewer.

AK: **Does it help project management? If so, how?**

BS: It make things easier, as can see how far things has progress, who commented it, and can select document or drawings that you want; the search system is useful and you never have to go back and ask the someone to send the document back to you again; make things easier for project management; the team only need to upload the document; therefore they need to change the way they used to work;

AK: **How about allocation of task? Does it help?**

BS: It can do allocation of task. Every time when you upload the document, you can allocate a task to certain company or person and it will flag up with the due date; however sending a letter, it doesn't flag up and remind you when is overdue. That function is similar to the email which can flag up for reminding purpose. For this project, if you logon to the BIW system, then the relevant flag will show and the overdue issues will be showed in different colour. it is a good tool for task allocation.

AK: **What about decision making? Does the Extranet help to make it happen easier?**

BS: Decision making is not easier; it can be happened by loading up something and then ask for final approval therefore it can be requested via Extranet for making decision; however need to educate everyone before using it. But the problem

Appendix D

is, say, on big project like this, you always have people changing, even the client. And these people are confined something that may not be issue to them if that is the confidential document.

AK: **Do you think it is a good tool that helps the project manager?**

BS: Yes, Extranet helps project manager

AK: **How much is the cost for the overall application of Extranet in this project?**

BS: Cost of Extranet is not one-off payment, but paying regularly for maintenance, the cost depends on size of project. If it is for a smaller project, it will have a bigger percentage of cost comparing to a big project, because it has a fixed amount for the initial installation.

AK: **Do you think if the investment in Extranet and its benefits can cover the costs?**

BS: Yes, if everyone buys extranet, so if the client, design team, contactor, project managers and all buy the extranet

AK: **Who pay the cost?**

BS: You can agree, if even the client, if you want to use it, you can somehow make the contractor to pay it if you wan to use the system. Or you could share it with the design and makes everyone to pay it for those who will use the extranet. It depends on how you want to set it up.

AK: **Is it difficult to make the others using the extranet but they may not want to use it because they do not have the experience in using the extranet?**

BS: Well, as a project manager we have to decide it and we need to motivate everyone to use it rather than using the email; We need to make sure everything is on there and everyone can find things.

AK: **For this project, who is paying?**

BS: It's the client paying for that. They are happy for that because they are remote and they also want to use it in the end for a full history of the overall project.

AK: **Do you think if this is a successful application?**

BS: The difficult thing is to train people as in a big project, there is always new people coming in and they don't know how to use it and they need to train again. It is because there are many different systems on the market and all of them are different, so you cannot start a project and assume everyone knows how to use it, like everyone knows how to use word, excel or outlook.

AK: **Maybe in the future, when Extranet becomes popular, then it will be easier, agree?**

BS: After it settle down and if only a few are in use rather than so many different ones that you need to make a choice at the beginning as they are all different and then you have to train yourself and after that train everyone else. The extranet is a process-oriented system. It is very structured in naming the document before you upload it otherwise no one can find it. Specific training is require learning all these processes and if somebody who is not trained properly then the Extranet will not work well.

AK: **What is the major spending when using the Extranet?**

BS: Training is the upfront cost when new people join the project. But there the major cost which is the huge backup system. Because the risk could happen and the information may lost. Also everyone relies on the system so much. So we need a firm which has a big IT system in their background.

AK: **Some people claim the extranet as an online-filing system, just like a shared drive, what do you think?**

BS: Some extranet systems only work like a online filing system, but some systems like the BIW provide more functions. They allow you to comment, specifically allocate task and flag up. There is a system call 4projects which is a filing system only and everybody can access it the same time. The biggest risk is that if everybody relies on the system very much and in case the system fails, then everything will get lost.

AK: **How to prevent the occurrence of losing the information when using the Extranet?**

BS: It never happens to me so far. Perhaps we will need to make sure the Extranet Company who deal with have a secure system and good track record. We need to make sure if this is a good and reliable firm because the project may last for four, five years.

AK: **What are the lessons learnt from the web-based application in this project?**

BS: Maybe it is not everyone buys in the system and therefore not everybody is using it. Maybe it is the client being too lazy to use it or the architects do not believe the advantages in using the Extranet. So if everyone is buying in the system, then all of them will use it. Also the contractor is based on site so they may require a sufficient internet connection to gain access all the documents.

AK: **Could that be the contractor who might find it more difficult in using the Extranet?**

Appendix D

BS: I would have thought the contractor is even beneficial in accessing the latest documents that don't need to search or criticise which is the latest document or even he could look up the drawing registers which is already in there. But if the contractor does not have enough connection to the access internet, then he might experience difficulties in downloading the files which is very time consuming. So the contractor needs to depend on their IT system for helping them to set up. Some of them may not have the internet access on-site.

AK: **So, what do you think about the major objectives in using the Extranet?**

depends on their requirements, some of them just needs an online-filing system, but some of them may require more functions

AK: **How about the motivation, could that be the technology?**

BS: Accessing the latest information, flexibility of document and accessing the documents which enable the ability to work remotely; some people do not want to make use of the new technology and you have to force them.

AK: **Can you see if the Extranet helps to bring the team together?**

BS: No.

AK: **Why not?**

BS: Because if you do start working remotely and issue a drawing in London and having the structural engineer comments on it. However two of them didn't sit down and discuss what the issues are and therefore it doesn't help. So I think it doesn't help to bring the team together.

AK: **Which one do you think is more effective? The traditional one or the modern one that uses Extranet?**

BS: Traditional is more effective in bringing the team together

AK: **Why do you think that?**

BS: "explaining" is important to tell about the reasons behind the changes that made in the drawings or documents however email and extranet does not allow this happen thoroughly

AK: **What are the changes to communication after using the Extranet?**

BS: Communication is not effectively used so far as people are using the Extranet as for exchanging files

Appendix D

AK: **What are the changes to information flow after using the Extranet?**

BS: For this project, information flow still depends on face-to-face to incorporate the comments and then upload the drawings or document

AK: **Have you done any risk management before making the consideration of using the Extranet in this project?**

BS: Risk management needed to carry out before the appropriate service provider is chosen

AK: **Do you think all projects can use the Extranet? Is that any particular ones that you would suggest that they shouldn't use?**

BS: I think all can use the Extranet but the small projects are no point to use the Extranet because they run very quickly and it will loss much time in setting up and training for projects within short period. But medium size should be more beneficial which last for at least two years and the team needs to stay very stable.

AK: **You mentioned the short-term advantages earlier, what about the ones in long-term?**

BS: Long term advantages involve the storage of the history over a long time and the information can be used as for the experience that can apply on the future projects.

AK: **Are the clients happy about using the Extranet?**

BS: Clients do not like to use it because it takes their precious time to doing the training. Anything that involves training sounds complicated to people and also the training takes time.

AK: **When is the best time to set up the Extranet?**

BS: The best time to set up the extranet is at the very beginning of the project

AK: **Does the whole team recognise about the benefits in the application of Extranet?**

BS: Most people know about the benefits in issuing and commenting the documents or drawing before they use them but they may not be happy when they need to do the training because they think they may use the time effectively.

AK: **What is the major problem that you experienced from the Finzel Reach project?**

BS: Main problem arise when not every one is not using the extranet, then the whole thing falls down. Sometimes the contractor or the small companies do not use the system but some the hardcopies are put in somewhere. At the end the various input made the system difficult in running. When start with the whole team, it contains specialist consultants and they do not know how to use it because it is a one-off job for them so at the end about 80% of information are available to share and 20% are at elsewhere.

AK: **From the survey, some problems come out, more people DISAGREED the following than agreed, the first one is : *Time, cost and quality are more certain***

BS: I would argue it has not much impact on time, cost and quality comparing to face-to-face meeting

AK: ***Clearer project organisational structure?***

BS: It is very often that the companies would allocate the junior staff to administrate the extranet so senior people even don't know how to use it. Sometimes the senior people asks the junior staffs to use the system and nobody would know if who is really the one who deal with the work or behind the administrator.

AK: ***Improve business relationships?***

BS: Only face-to-face meeting could improve business relationships that people need to meet each other and the tool cannot help to improve relationship at all.

AK: ***More opportunities for partnering?***

BS: same as previous answer

AK: **That is the end of the questions and thank you very much for your corporation.**